

**EVALUATION OF THE NUTRITION ASSISTANCE
PROGRAM IN PUERTO RICO**

**Volume II
Effects on Food Expenditures and Diet Quality**

Prepared by:

MATHEMATICA POLICY RESEARCH

Prepared for:

**U.S. Department of Agriculture
Food and Nutrition Service
Office of Analysis and Evaluation**

Submitted to:

**Committee on Agriculture
Nutrition and Forestry
United States Senate**

**Committee on Agriculture
United States House of
Representatives**

June 1, 1985

CONTENTS

<u>Chapter</u>	<u>Page</u>
EXECUTIVE SUMMARY.....	v
PREFACE	xi
I. OVERVIEW.....	I-1
A. THE NUTRITION ASSISTANCE PROGRAM.....	I-1
B. THE OBJECTIVES OF THIS REPORT.....	I-6
C. THE COMPANION REPORT.....	I-7
D. THE ORGANIZATION OF THIS REPORT.....	I-8
II. DESCRIPTION OF HOUSEHOLD CHARACTERISTICS IN 1977 AND 1984.....	II-1
A. DESCRIPTION OF DATA.....	II-1
B. HOUSEHOLD CHARACTERISTICS.....	II-8
III. THE IMPACT OF NAP ON FOOD EXPENDITURES.....	III-1
A. ANALYSIS STRATEGY.....	III-1
B. DESCRIPTIVE ANALYSIS OF FOOD EXPENDITURES.....	III-3
C. STATISTICAL ANALYSIS OF FOOD EXPENDITURES.....	III-8
D. RESULTS OF THE ANALYSIS OF CASH ISSUANCE AND RESTRICTIONS ON ELIGIBILITY AND BENEFITS.....	III-19
E. CONCLUSIONS.....	III-28
IV. THE IMPACT OF NAP ON NUTRIENT AVAILABILITY.....	IV-1
A. ANALYSIS STRATEGY.....	IV-2
B. DESCRIPTIVE ANALYSIS OF NUTRIENT AVAILABILITY.....	IV-3
C. STATISTICAL ANALYSIS OF NUTRIENT AVAILABILITY.....	IV-15
D. RESULTS OF THE ANALYSIS OF NAP'S EFFECTS ON THE PERCENT OF HOUSEHOLDS FAILING TO ATTAIN RDA.....	IV-23
E. CONCLUSIONS.....	IV-34
REFERENCES.....	R-1
APPENDIX A - RESULTS OF THE TIME-SERIES ANALYSIS OF FOOD EXPENDITURES.....	A-1
APPENDIX B - TABULAR ESTIMATES OF THE IMPACT OF NAP ON FOOD EXPENDITURES AND NUTRIENT AVAILABILITY.....	B-1
APPENDIX C - TECHNICAL APPENDIX FOR THE ANALYSIS OF FOOD EXPENDITURES AND NUTRIENT AVAILABILITY.....	C-1
APPENDIX D - ANALYSIS OF THE POSSIBILITY OF EFFECTS OF THE ELIMINATION OF THE FOOD STAMP PURCHASE REQUIREMENT.....	D-1
APPENDIX E - SUPPLEMENTAL TABLES.....	E-1

TABLES

<u>Table</u>		<u>Page</u>
I.1	ESTIMATED CHANGES IN NAP BENEFITS BY NATURE OF PROGRAM CHANGE, JULY 1982 TO DECEMBER 1984.....	I-5
II.1	SELECTED CHARACTERISTICS OF HOUSEHOLDS IN PUERTO RICO, 1977 AND 1984: HOUSEHOLD SIZE, INCOME, AND PARTICIPATION IN FOOD ASSISTANCE PROGRAMS.....	II-11
II.2	SELECTED CHARACTERISTICS OF HOUSEHOLDS IN PUERTO RICO, 1977 AND 1984: SOCIAL AND DEMOGRAPHIC CHARACTERISTICS.....	II-14
II.3	SELECTED CHARACTERISTICS OF HOUSEHOLDS IN PUERTO RICO, 1977 AND 1984: FOOD PURCHASING AND PREPARATION.....	II-16
III.1	FOOD EXPENDITURES IN PUERTO RICO, 1977 AND 1984.....	III-5
III.2	SAMPLE SIZES AND AVERAGE VALUES OF FOOD EXPENDITURES FOR STATISTICAL ANALYSIS OF FOOD EXPENDITURES.....	III-12
III.3	SIMULATION RESULTS FOR TOTAL FOOD EXPENDITURES AND THE MONEY VALUE OF FOOD USED AT HOME.....	III-29
III.4	SAMPLE SIZES AND AVERAGE VALUES OF FOOD EXPENDITURE MEASURES FOR STATISTICAL ANALYSIS OF FOOD EXPENDITURES.....	III-15
III.5	ESTIMATES OF MARGINAL PROPENSITY TO CONSUME FOOD.....	III-19
IV.1	QUANTITY OF FOOD USED PER PERSON IN A WEEK IN PUERTO RICO, 1977 AND 1984.....	IV-6
IV.2	NUTRIENT AVAILABILITY PER DOLLAR OF FOOD USED AT HOME BY HOUSEHOLDS IN PUERTO RICO, 1977 AND 1984.....	IV-8
IV.3	NUTRITIVE VALUE OF FOOD USED AT HOME PER NUTRITION UNIT PER DAY IN PUERTO RICO, 1977 AND 1984.....	IV-10
IV.4	PERCENTAGE OF HOUSEHOLDS MEETING THE RECOMMENDED DIETARY ALLOWANCES (1980) IN PUERTO RICO, 1977 AND 1984.....	IV-12
IV.5	ESTIMATED EFFECTS OF \$1 INCREASE IN FOOD USED AT HOME ON THE AVAILABILITY OF FOOD ENERGY AND FIVE NUTRIENTS, FOR FOOD-STAMP-ELIGIBLE PUERTO RICO HOUSEHOLDS IN 1977 AND 1984.....	IV-20
IV.6	THE PREDICTED EFFECT OF NAP, RELATIVE TO NO FOOD ASSISTANCE PROGRAM FOR THE GENERAL LOW-INCOME POPULATION, ON THE PERCENT OF PUERTO RICO HOUSEHOLDS FAILING TO ATTAIN SELECTED RDA.....	IV-35

APPENDIX TABLES

Appendix Table

Page

A.1	ESTIMATES OF THE MARGINAL PROPENSITIES TO CONSUME FOOD AND NONFOOD PRODUCTS FROM INCOME AND FOOD STAMP PROGRAM BENEFITS IN PUERTO RICO, FY 1948-FY 1982.....	A-5
A.2	OLS ESTIMATION RESULTS FOR PER-CAPITA PERSONAL CONSUMPTION EXPENDITURE ON FOOD AND NONFOOD PRODUCTS IN PUERTO RICO, FY 1948-FY 1982.....	A-6
A.3	MEANS AND STANDARD DEVIATIONS FOR DEPENDENT AND EXPLANATORY VARIABLES, FY 1948-FY 1982.....	A-7
B.1	CHANGES IN FOOD EXPENDITURES IN PUERTO RICO BETWEEN 1977 AND 1984.....	B-4
B.2	MEAN VALUES OF FOOD EXPENDITURES IN PUERTO RICO BY ELIGIBILITY AND PARTICIPATION STATUS, 1977 AND 1984..	B-5
B.3	CHANGES IN AVERAGE NUTRITIVE VALUE OF FOOD USED AT HOME PER NUTRITION UNIT PER DAY IN PUERTO RICO BETWEEN 1977 AND 1984.....	B-8
B.4	CHANGES IN PERCENTAGE OF HOUSEHOLDS MEETING RECOMMENDED DIETARY ALLOWANCES IN PUERTO RICO BETWEEN 1977 AND 1984.....	B-9

APPENDIX TABLES (continued)

<u>Appendix Table</u>	<u>Page</u>
C.8 ESTIMATES OF EQUATIONS EXPLAINING THE AVAILABILITY OF FOOD ENERGY AND SELECTED NUTRIENTS IN FOOD USED FROM HOME FOOD SUPPLIES BY FOOD-STAMP-ELIGIBLE PUERTO RICO HOUSEHOLDS IN 1977.....	C-20
C.9 ESTIMATES OF EQUATIONS EXPLAINING THE AVAILABILITY OF FOOD ENERGY AND SELECTED NUTRIENTS IN FOOD USED FROM HOME FOOD SUPPLIES BY FOOD-STAMP-ELIGIBLE PUERTO RICO HOUSEHOLDS IN 1984.....	C-21
C.10 PROCEDURE FOR SIMULATING THE EFFECT OF CASH ISSUANCE ON TOTAL FOOD EXPENDITURES.....	C-22
C.11 PROCEDURE FOR SIMULATING THE EFFECT OF RESTRICTIONS ON ELIGIBILITY AND BENEFITS ON TOTAL FOOD EXPENDITURES.....	C-23
C.12 IMPLIED EFFECTS OF RESTRICTIONS ON PROGRAM ELIGIBILITY ON NUTRIENT AVAILABILITY FOR A TYPICAL HOUSEHOLD BASED ON STATISTICAL ESTIMATES.....	C-24
C.13 PROCEDURE FOR SIMULATING THE EFFECT OF CASH ISSUANCE ON TOTAL FOOD EXPENDITURES.....	C-29
C.14 PROCEDURE FOR SIMULATING THE EFFECT OF RESTRICTIONS ON ELIGIBILITY AND BENEFITS ON TOTAL FOOD EXPENDITURES.....	C-31
E.1 ESTIMATED CHANGES IN NAP BENEFITS BY NATURE OF PROGRAM CHANGE, JULY 1982 TO DECEMBER 1984.....	E-1
E.2 SELECTED CHARACTERISTICS OF HOUSEHOLDS IN PUERTO RICO, 1977 AND 1984: HOUSEHOLD SIZE, INCOME, AND PARTICIPATION IN FOOD ASSISTANCE PROGRAMS.....	E-4
E.3 FOOD EXPENDITURES IN PUERTO RICO, 1977 AND 1984.....	E-5

FIGURES

<u>Figure</u>	<u>Page</u>
III.1 SIMULATION RESULTS FOR WEEKLY TOTAL FOOD EXPENDITURES, 1984.....	III-23
III.2 SIMULATION RESULTS FOR WEEKLY VALUE OF FOOD USED AT HOME, 1984.....	III-27
IV.1 DIAGRAMATIC REPRESENTATION OF THE STATISTICAL ANALYSIS OF NUTRIENT AVAILABILITY.....	IV-17
IV.2 SIMULATION RESULTS FOR EFFECT OF CASH ISSUANCE ON NUTRIENT AVAILABILITY, 1984.....	IV-25
IV.3 SIMULATION RESULTS FOR EFFECT OF RESTRICTIONS ON ELIGIBILITY AND BENEFITS ON NUTRIENT AVAILABILITY, 1984.....	IV-28

APPENDIX FIGURES

<u>Appendix Figure</u>	<u>Page</u>
D.1 ACTUAL AND PREDICTED DENSITY OF FOOD EXPENDITURES.....	D-6

EVALUATION OF THE NUTRITION ASSISTANCE
PROGRAM IN PUERTO RICO

Volume II
Effects on Food Expenditures and Diet Quality

EXECUTIVE SUMMARY

The primary objective of this evaluation, mandated by Public Law 98-204, is to analyze the effects of the Nutrition Assistance Program (NAP) on food expenditures and diet quality. NAP replaced the Food Stamp Program (FSP) in Puerto Rico in 1982. In contrast to the FSP, NAP provides benefits in the form of checks rather than food coupons and it has more restricted income eligibility and benefit levels. The effects of NAP's cash issuance provision were analyzed separately from the effects of NAP's restrictions on program eligibility and the level of benefits. The evaluation used two measures of household food expenditures--total food expenditure, which includes food used at home and away from home, and the money value of food used at home--and several measures of diet quality. The total food expenditure variable provides the most comprehensive measure of food expenditures, while the value of food used at home is more consistent with the nutrition measures, as they are based on food used at home. The analysis using these measures consistently shows that NAP, and particularly the cash issuance components of NAP, did not lead to major changes in household food expenditures or diet quality. In particular, while NAP led to a small reduction in the total food expenditure of households, the change to cash issuance itself had no effect. Other measures of household food expenditure and nutrient availability showed small declines due to NAP and smaller still due to cash issuance. These changes are not different from zero in a statistical sense.

The NAP Changes

On July 1, 1982, the Commonwealth of Puerto Rico began operating a cash food assistance program, known as the Nutrition Assistance Program, as a replacement for the existing Food Stamp Program. The FSP had provided eligible low income individuals and families with assistance since 1974 in the form of food coupons. This program change was implemented as a result of the mandate of the Omnibus Budget Reconciliation Act of 1981 (Public Law 97-35) that Puerto Rico's participation in the U.S. Food Stamp Program be replaced by an annual \$825 million block grant to provide food assistance for needy persons, and because Puerto Rico subsequently decided to replace food coupons with direct cash assistance.

The Nutrition Assistance Program differs from the June 1982 Puerto Rico Food Stamp Program in three important respects: the food coupons have been replaced by cash benefits; income eligibility limits and benefits have been reduced to bring program costs into line with the reduced funding

level of the block grant; and the block grant program has been capped at an annual budget of \$825 million.

The Companion Report

The secondary objective of this evaluation is to describe the setting of the switch to NAP in terms of the unique socioeconomic and demographic environment of Puerto Rico, and to report on the effects of NAP on program benefits and participation, administrative costs, and fraud and error. The information requested by Congress on the secondary objective was provided in an Interim Report on March 1, 1985. That Interim Report was subsequently reissued as a companion volume to this current report and retitled Evaluation of the Nutrition Assistance Program in Puerto Rico, Volume I: Environment, Participation, Administrative Costs, and Program Integrity.

The major findings of Volume I were:

- o The Puerto Rico program setting is markedly different from that of any of the 50 states, and generalizations from Puerto Rico to any of the 50 states or vice versa may not hold.
- o NAP retargeted benefits to households with less income, producing a smaller participating population. By September 1984, participation was down 111,000 households, a decline of 22 percent from June 1982 FSP levels.
- o NAP administrative costs are lower than under the FSP, largely due to cash issuance which saved about 6 million dollars.
- o NAP also eliminated the potential for trafficking in food coupons which was reported as a common occurrence under the FSP.

The Analyses

This analysis of the effects of NAP on food expenditures and diet quality is based on household food use survey data collected before and after the introduction of NAP. The first survey of household food use in Puerto Rico was conducted in 1977 and the second in 1984. The objectives of this analysis were achieved through three basic steps:

1. A descriptive examination of the changes from 1977 to 1984 in household food expenditures and diet quality, as well as changes in potential explanatory factors such as

income and household size. This examination quantified gross differences and identified factors other than NAP that might confound the analysis.

2. A formal statistical analysis that provides estimates of the effects of NAP on household food expenditures after controlling for other factors. A second component estimates the effect of changes in food expenditures on nutrient availability.
3. A simulation analysis that allows the cash issuance aspect of NAP to be evaluated separately from the restrictions on eligibility and benefits.

Household Characteristics in 1977 and 1984

In order to make meaningful cross-year comparisons, similar groups must be defined for 1977 and 1984 that take into account the change in eligibility requirements under NAP. Participant households in 1977 are divided into those which would have been eligible under the stricter requirements of NAP and those that would have been ineligible for NAP (after adjusting for inflation). In the following discussion, comparisons are for 1977 NAP-eligible participants in the FSP and 1984 NAP participants unless clearly indicated otherwise. Note also that all dollar values are in constant (1984) dollars, and all changes are in real terms.

1977 NAP-Eligible Participants versus 1984 NAP Participants. NAP-eligible participants were similar in both years; however, there were important changes over the seven years.

- o The average size of participating households declined by about .5 persons from 1977 to 1984 because of fewer children per household.
- o The components of income changed from 1977 to 1984 for participating households, but total income, including program benefits, was unchanged.
 - Average weekly income, excluding program benefits, rose by about \$7, a 10 percent increase.
 - The average amount of weekly food assistance fell by approximately \$6, a 14 percent decrease.
 - Average income plus food benefits was about \$110 in both 1977 and 1984.

All Puerto Rico Households versus NAP-Eligible Participants. Both the 1977 and the 1984 data indicate that participating households relative

PREFACE

This report was prepared by Mathematica Policy Research under contract no. 53-3198-4-63 from the U.S. Department of Agriculture, Food and Nutrition Service, Office of Analysis and Evaluation.

This report represents a team effort in which many individuals made key contributions in addition to the authors. We gratefully acknowledge their assistance. We would like to recognize the sustained help and encouragement of Linda Esrov, the Food and Nutrition Service Project Officer. The members of the project advisory panel, Stanley Johnson, Lance Taylor, and David Wise, provided important comments on the analysis plans and preliminary results, as did Mary Hama, Human Nutrition Information Service, Department of Agriculture, and David Smallwood, Economic Research Service, Department of Agriculture.

The authors acknowledge their intellectual debt to earlier household food expenditure research, particularly the work of Stanley Johnson, Jain-Shing Chen and their colleagues at the University of Missouri; David Smallwood and James Blaylock at the Economic Research Service, Department of Agriculture; and Laura Blanciforti, formerly at the Economic Research Service.

The authors would also like to thank the numerous individuals associated with Mathematica Policy Research who helped with this report: Felicity Skidmore, the consulting editor for the manuscript; Robert Moffitt who played a critical role as a consultant on econometric issues; Nancy Johnson of the University of Wisconsin and Karen Morgan of the University of Missouri who served as nutrition consultants; John Burghardt and Jim Ohls who provided important advice; Deborah Reichert, David Ribar, Judy Richter, Mark Rucci, and Linda Wray who provided programming and research assistance support; and Marjorie Mitchell and Lucia Wesley and the other secretaries.

Harold Beebout
Edward Cavin
Barbara Devaney
Thomas Fraker
Sharon Long
Peter Mossel

Overall Changes in Food Expenditures Between 1977 and 1984

Results from the descriptive analysis indicate average food expenditures declined from 1977 to 1984.

- o Comparing NAP-eligible participants in 1977 to 1984 NAP participants, the decline is 6.7 percent for total food expenditures and 6.0 percent for the money value of food used at home.
- o However, total food expenditures fell by 2.4 percent for all Puerto Rico households, and the average money value of food used at home fell by 3.3 percent, indicating that other trends independent of NAP were affecting food expenditure between 1977 and 1984. Statistical analysis was needed to disentangle the NAP effects.
- o There was a shift in the source of food used at home for NAP-eligible participants between 1977 and 1984, with declines in purchased food and increases in home-produced food and food received as a gift or payment.
- o There was also an increase of \$.14 per person per week on food away from home for NAP-eligible participants from 1977 to 1984. This increase mirrored a larger shift for all households.

NAP Effects on Food Expenditures

In comparison to the former FSP, NAP was expected to reduce food expenditures because of the restrictions on eligibility and benefits and the cash form of issuance. However, trafficking in coupons, which had occurred under the FSP, was expected to reduce the magnitude of the cash issuance effect. To the extent that food coupons were easily exchanged for cash prior to NAP, cash issuance would not represent a major program change.

- o The statistical analysis indicates that NAP resulted in reductions in total food expenditures of about 2.0 percent and reductions in the money value of food used at home by about 4.4 percent for participants in the former FSP.
- o Results from the statistical and simulation analyses provide separate estimates for the impact of cash issuance and for the restrictions on eligibility and benefits on FSP participants.

- The change to cash issuance had no effect on total weekly food expenditures per person, but resulted in a 70 cent or 2.4 percent decline in the money value of food used at home.
- Restrictions on eligibility and benefits caused total weekly food expenditures per person to fall by about 70 cents or 2.3 percent, and the money value of food used at home per person to fall by about 60 cents or 2.0 percent.

Overall Changes in Nutrient Availability Between 1977 and 1984

The examination of the change in nutrient availability between 1977 and 1984 indicated that:

- o The quality of the diets of participating households was generally high in both 1977 and in 1984.
 - The average nutritive values of food used at home by participant households were considerably above the Recommended Dietary Allowances (RDA).
 - For food energy and for 8 of the 11 nutrients examined, the RDA were met by over 70 percent of the participant households in both years.
 - In terms of the quantity of food used by food group, the use of fruit and grain products increased while the use of dairy products fell, with little change in the quantities used of the other products.
- o The quality of the diets of NAP participants in 1984 was generally equivalent to or better than that of NAP-eligible participants in 1977. An increase in the efficiency with which participants purchased nutrients made the achievement of diet quality possible in the face of reduced food expenditures.
 - There was an increase in nutrient availability per dollar of food used at home for all nutrients except for vitamin B₁₂, which fell slightly.
 - The percentage of households satisfying the RDA for specific nutrients generally increased from 1977 to 1984. The exceptions were riboflavin and vitamin B₁₂.

NAP Effects on Nutrient Availability

Since nutrient availability was expected to be linked to food expenditures, any decline in food expenditures because of the switch to NAP could be expected to result in a reduction in diet quality. However, as just discussed, because the effects on food expenditures were small, small effects on nutrient availability were also expected.

- o The statistical and simulation analyses of the effects of NAP indicate a reduction in the availability of nutrients from food used at home. The reductions follow directly from the earlier findings that expenditures on food used at home were less under NAP and that food expenditures are linked to nutrient availability.
 - The cash issuance component of NAP increased the proportion of households failing to achieve the RDA. The increase across food energy and five selected nutrients ranged from 0.7 percentage points for calcium to 2.5 percentage points for vitamin B₆. However, in a statistical sense these NAP reductions are not different from zero.
 - The restrictions on eligibility and benefits under NAP also increased the proportion of households failing to achieve the RDA. The increase ranged from 1.2 percentage points for food energy to 2.4 percentage points for iron and vitamin B₆.
 - It is important to note that these results for nutrient availability consider only food used at home and ignore food consumed away from home because of data limitations.
- o The finding that NAP resulted in small reductions in nutrient availability might appear to contradict the finding from the descriptive analysis that diet quality generally improved when 1977 NAP-eligible participants are compared with 1984 NAP participants. Some aspects of this apparent contradiction remain, but the following helps reconcile the two:
 - The nutrient availability per dollar spent on food at home increased from 1977 to 1984. Apparently, Puerto Rico households started purchasing more nutritious foods for their food dollar. No direct evidence was available on whether or not this shift was related to NAP.

- The statistical analyses appropriately attempt to remove the influences of all other factors, such as increasing educational attainment, and to estimate the pure effect of the cash issuance and restrictions on eligibility and benefits components of NAP. In contrast, the comparison of 1977 and 1984 groups in the descriptive analysis combines NAP effects with all the other influences.
- All of the changes are small and the expenditure changes due to cash issuance that underlie the changes in nutrient availability are not significant in a statistical sense. Hence, the cash issuance effects on nutrient availability are also not different from zero in a statistical sense.

Conclusion

In summary, the study shows that providing benefits in the form of cash rather than coupons in Puerto Rico has had little or no effect on the food expenditures or quality of diets of households in Puerto Rico. Restricted eligibility and benefit levels have produced small reductions in food expenditure and diet quality.

I. OVERVIEW

This study, mandated by Public Law 98-204, has two objectives. The primary objective is to analyze the effects of the cash food assistance program in Puerto Rico, known as the Nutrition Assistance Program, on food expenditures and diet quality. The results of this primary analysis are presented in this report. The secondary objective is to describe the environment in which the program was implemented and assess program participation, administrative costs, and program integrity after more than two years of program operation. A report on the results of that assessment was submitted to Congress in March 1985.^{1,2}

A. THE NUTRITION ASSISTANCE PROGRAM

On July 1, 1982, the Commonwealth of Puerto Rico began operating a cash food assistance program, known as the Nutrition Assistance Program (NAP), to replace the existing Food Stamp Program (FSP) which since 1974 had provided eligible low income individuals and families with assistance in the form of food coupons. This program change was implemented as a result of two events. The Omnibus Budget Reconciliation Act of 1981 (Public Law 97-35) mandated that Puerto Rico's participation in the U.S. Food Stamp Program be replaced by an annual \$825 million block grant to

¹That report is Volume I of this study--Evaluation of the Nutrition Assistance Program in Puerto Rico: Environment, Participation, Administrative Costs, and Program Integrity.

²An earlier study, mandated by Public Law 97-253, focused on the initial implementation of the Nutrition Assistance Program and its early effects on program participation and costs; a report on the results of the first study was submitted to Congress in March 1983.

provide food assistance for needy persons. This was followed by Puerto Rico's decision to replace food coupons with direct cash assistance.

NAP continued to serve the same program purpose as the FSP:

"To . . . permit low income households to obtain a more nutritious diet through normal channels of trade by increasing food purchasing power."¹

NAP also continued to use the same basic program structure and retained most of the operational features of the FSP. However, NAP differs from the June 1982 Puerto Rico Food Stamp Program in three important respects.²

First, the food coupons have been replaced by cash benefits. This is a key NAP operational change in terms of the objectives of this evaluation because it changes the form of the benefit issuance: under NAP, recipients receive monthly benefits in the form of a check rather than as coupons. Under the former FSP, each authorized household was mailed an authorization to participate (ATP) card each month. Recipients then exchanged the ATP card for food stamps at their local Department of Social Services office. Under NAP, checks are mailed directly to recipients from a central processing facility. Like food coupons, the checks are intended to increase the food purchasing power of recipients. But, unlike food coupons, NAP checks are freely negotiable for currency.

Second, the switch to NAP included reductions in eligibility limits and benefit standards in order to bring program costs into line with the legislatively reduced funding level of the block grant budget.

¹Public Law 95-113, Food Stamp Act of 1977, Sec. 2.

²The NAP program changes are described in detail in Volume I of the Evaluation of the Nutrition Assistance Program in Puerto Rico, pp. II-24 to II-30.

Third, the program has been capped at the block grant level of \$825 million. This means that, unlike the FSP, NAP is not indexed for inflation. The NAP gross income limit for a household of four is \$8 000 per year, compared with the limit of \$13,260 that would have applied for the former FSP in November 1984.¹ Similarly, the NAP maximum benefit for the same household is \$199, compared with the estimated \$250 under the former FSP.² Further, under NAP the benefit amounts may be adjusted up or down each month by the proportion required to bring aggregate benefits into line with available funds under the \$825 million block grant.

The net impact of the program changes during the first three months following the implementation of NAP was a reduction of \$8.9 million (about 12 percent) in the monthly amount of benefits distributed. That reduction can be attributed to specific NAP changes as shown in Table I.1, although the exact amounts attributed to these changes should be viewed as

¹The NAP gross income eligibility limit for a household of four was fixed at an annual level of \$8,000, compared to the June 1982 FSP limit of \$10,985. Subsequent inflation adjustments increased the FSP limit to \$13,260 as of November 1984. Thus, the NAP income eligibility limits in November 1984 were 40 percent smaller than the limits that would have been in effect under the former FSP. Proportional changes also occurred in the FSP net income limits.

²The NAP maximum benefit for a household of four was set at \$199, which was 90 percent of the Puerto Rico FSP maximum benefit of \$221 in June 1982. From June 1982 to November 1984, the FSP maximum benefit for the continental United States has increased from \$233 to \$264 for a household of four, a 13 percent change. Applying the 13 percent increase to the Puerto Rico amount of \$221 produces the estimate of \$250. With constant average income (in nominal terms) and average benefits equal to 80 percent of the maximum benefit, the 13 percent increase in the maximum benefit translates into the 16 percent increase in the average benefit used in the Chapter IV simulations.

TABLE I.1

ESTIMATED CHANGES IN NAP BENEFITS BY NATURE OF PROGRAM CHANGE,
JULY 1982 TO DECEMBER 1984

NAP Change From FSP Levels	Monthly Amount per Household (Dollars)	Number of Households (1,000)	Total Monthly Amount (\$1,000)
FSP June 1982	146.69	515.4	75,604
NAP July 1982 - September 1982			
NAP Change in Maximum Benefit	-20.05	460.2	-9,227
NAP Pro Rata Adjustment	10.96	460.2	5,044
Elimination of Indexing of Benefits	-0-	460.2	-0-
Eligibility Provisions	-85.40	55.4	<u>-4,731</u>
Total			-8,914
NAP October 1984 - December 1984			
NAP Change in Maximum Benefit	-20.45	402.8	-8,237
NAP Pro Rata Adjustment	20.29	402.8	8,173
Elimination of Indexing of Benefits	-27.45	402.8	-11,057
Eligibility Provisions	-112.85	95.0	<u>-10,721</u>
Total			-21,842

NOTE: This table appears as appendix Table E.1 with footnotes appended providing sources and technical details.

B. THE OBJECTIVES OF THIS REPORT

The bill which extended the cash Nutrition Assistance Program in Puerto Rico (H.R. 4252, later passed as Public Law 98-204) mandated the current evaluation. As noted, the primary objective of this evaluation is to determine whether NAP--by replacing food coupons with cash assistance and by restricting eligibility and benefits--has affected food expenditures of participating households and the nutritional adequacy of their diets.

The intent of the research is to answer questions such as the following:

- o What was the change in household food expenditures from 1977 to 1984? How much of that change was due to:

Cash issuance?

Restrictions on eligibility and benefits?

- o What was the change in nutrient availability from 1977 to 1984? How much of that change was due to:

Cash issuance?

Restrictions on eligibility and benefits?

In order to assess whether food expenditures and diet quality were affected by cash issuance and restrictions on eligibility and benefits, information is needed on household food expenditures and nutrient availability before and after the conversion to NAP. These data on food expenditures and nutrient availability are available from two Puerto Rico household food consumption surveys. The first was a supplement to the Nationwide Food Consumption Survey and was fielded during 1977 when the former FSP was in effect. The second was a similar survey conducted during 1984, after Puerto Rico's cash NAP had been operating for over two years.

Both descriptive and formal statistical approaches are used in the analysis. Tabular comparisons of the 1977 and 1984 data provide an estimate of the total differences in food expenditures and nutrient availability between the two years. These differences are the result of NAP as well as all other influences on food expenditures and nutrient availability. The limited ability of tabular comparisons (which are essentially comparisons of average values) to isolate the impact of NAP on food expenditures and nutrient availability from the confounding effects of other factors unrelated to NAP, is the reason for the formal statistical analysis. In the statistical analysis of food expenditures, both program participation and food expenditures are analyzed, and the resulting estimates are used to obtain the separate effects of the change from coupons to cash and the restrictions on eligibility and benefits. The effects of NAP on the nutritional adequacy of diets are obtained from the statistical estimates of the effect of food assistance benefits on food expenditures and the effect of food expenditures on nutrient availability.

The results of the analyses of household food expenditures and diet quality are presented in Chapters III and IV respectively.

C. THE COMPANION REPORT

The companion report, first submitted to Congress in March 1985, provides contextual and program information which constitute the background for this assessment of the impacts of NAP on food expenditures and nutrition.

Questions on the economic and demographic context examined in the earlier report include the following:

- o How have population growth, urbanization, and changing demographic composition affected poverty and hence, the scale of the food assistance program?
- o How have economic growth and employment, interacting with the demographic factors, affected poverty and hence, the scale of the food assistance program?
- o What do vital statistics data tell us about trends in health status in Puerto Rico?
- o What has been the pattern of food consumption in Puerto Rico over time, and how does it relate to economic changes, demographic changes, and food assistance program changes?

Questions on program participation, administrative costs, and program integrity examined in the companion report include the following:

- o What have been the effects of the switch to NAP on benefits and participation over the past two years? What were the earlier effects of the elimination of the purchase requirement (EPR)?
- o How has the composition of participating households changed in the switch to NAP?
- o What were the administrative cost savings generated by the switch to NAP?
- o What was the level of fraud and error in the Puerto Rico FSP, and what was the change under NAP?
- o What was the extent of food stamp trafficking, and how may that affect the expected impact of cash issuance?

D. THE ORGANIZATION OF THIS REPORT

The organization of this report follows. The data used in the analysis of the NAP impact on food expenditures and nutrient availability, together with descriptive information comparing participating as well as

all sample households between 1977 and 1984, are presented in Chapter II. The results of the analysis of the impact of NAP on food expenditures and on nutrient availability, including estimates of the separate effects of cash issuance and of restrictions on eligibility and benefits, are presented in Chapters III and IV respectively.

II. DESCRIPTION OF HOUSEHOLD CHARACTERISTICS IN 1977 AND 1984

The evaluation approach specified by Public Law 98-204 and the accompanying House Report (Congressional Record, November 15, 1983, H9893) is a comparison of Puerto Rico households which receive cash food assistance with Puerto Rico households which receive coupons. Since no data on food expenditures and nutritional adequacy of diets were available for households which receive cash food assistance, Congress specified that data be collected on food use by Puerto Rico households which receive cash benefits under NAP. The survey was fielded in Puerto Rico between July 1984 and December 1984 and is called the 1984 Puerto Rico Household Food Consumption Survey. This evaluation is based on data from both the 1984 survey and earlier food use data collected between July 1977 and December 1977 as part of the Puerto Rico Supplement to the Nationwide Food Consumption Survey.¹

A. DESCRIPTION OF DATA

The 1977 and 1984 survey samples were both representative of the Island's population. They were also almost identical in terms of the data collection methodology. Within this basic similarity, the 1984 analysis sample was somewhat smaller than the 1977 analysis sample (2,423 households in 1984 versus 2,940 households in 1977). The 1984 sample was also designed to contain a proportionately greater share of households which

¹Data on household food use from the 1977 Puerto Rico survey are described in USDA/HNIS Preliminary Report No. 9 (1982a).

participated in the FSP but were ineligible for NAP because of its more stringent income eligibility limits.

1. Data on Household Food Use

These two surveys provide detailed information on household food use.¹ Household food use refers to food and beverages (alcoholic and nonalcoholic) used from household food supplies during the seven days preceding the interview. Included are: food and beverages consumed at home; food and beverages carried from the home and eaten elsewhere; food fed to pets or discarded; and all food brought into the household for consumption, including any part that was discarded either before or after preparation. Food purchased with cash, credit, or food stamps and food that was home-produced, received as a gift or payment for work, or received through other programs are all included in the measure of household food use. Ordinary pet food, food given to animals for commercial purposes, food and beverages given away or sold to persons outside the household, and food and beverages bought, but not yet consumed, are not included.

It is important to note that household food use is not equivalent to food intake by individuals in the household. Food intake refers to food actually eaten and is, in general, substantially less than food used. The difference between the amount of food that disappears from the household

¹The 1977 Puerto Rico survey also included a 24-hour recall of food intake by individuals. These data are not used in the Puerto Rico evaluation, since comparable data for 1984 do not exist. Findings from the individual intake data are presented in USDA/HNIS Preliminary Report No. 12 (1982b).

food supplies and actual food intake can be attributed to food waste or loss and to differences in the survey methodologies.¹

The survey methodology was based on a seven-day recall of food used from household food supplies. Respondent households had been contacted at least seven days prior to the actual interview and asked to maintain records of shopping lists, menus, grocery receipts, prices of food, and labels that would help them provide information on food use. Trained interviewers administered the interview in Spanish to the person in the household who had primary responsibility for meal planning and preparation. For each food item used from household food supplies during the previous seven days, the interviewer recorded the type of food, form (fresh, canned, or frozen), quantity used, price paid (if appropriate), and source (purchased, home-produced, or gift or pay). Data were also collected on the number and type of meals (morning, noon, or evening) eaten from household food supplies by household members and others, on the snacks and refreshments eaten by guests, and on meals eaten away from home by household members. In addition to the data on food use, information was obtained on household characteristics presumed to be related to food use

¹The main differences between the survey methodologies for obtaining data on food use and food intake which could lead to disparities between the quantity used and the quantity eaten are: (1) the two surveys usually cover different time periods, with the food intake survey covering between 1 to 3 days and the food use survey covering a 7-day period; (2) weekend days, which are relatively high consumption days, are reported less frequently for the food intake surveys than other days of the week; and (3) a larger number of meals at home are reported in food use surveys than in food intake surveys.

and diet quality--such as participation in the FSP and NAP, participation in other food assistance programs (School Lunch; School Breakfast; Special Supplemental Food Program for Women, Infants, and Children (WIC); or programs for the elderly), household composition, income, education and employment of the household heads, urbanization, tenancy, and food buying practices.

Total food expenditures from these surveys are the sum of the money value of food used at home, the amount spent on meals and snacks away from home, and the subsidy value of school lunches and school breakfasts. The money value of food used at home includes the value of food used from household food supplies by household members, roomers, boarders, employees, and guests. It is derived from the quantity of the individual food items used by the household during the seven-day period preceding the interview. The money value of food used is obtained by multiplying the quantity (in pounds) of each food item used by its respondent-reported price per pound. Food not purchased directly by the household (i.e., home-produced food or food received as a gift or pay) is valued at the average price per pound for that food item that was paid by the survey households reporting its purchase and use. The total money value of food used at home is obtained by summing the money values of the individual food items.

2. Data on Household Nutrient Availability

Data on household food energy and nutrient availability are also calculated from the quantity of each food item used by the household. Caloric and nutrient contents of each food item are obtained from tables of

the nutritive value of foods.¹ Total household availability of food energy is derived by summing the food energy of the individual food items used. The household availability of nutrients is obtained in similar fashion by summing the nutritive values of the individual food items. Nutritive values pertain to the edible portion of the food used from household food supplies, with some adjustments for vitamin losses during preparation.

A crucial feature of both the 1977 and 1984 surveys is that household nutrient availability data are based on food used from household food supplies. This point has two important implications. First, just as food used exceeds food intake, nutrient availability overstates nutrient intake.² Second, nutritive values are not available for food eaten away from home. Thus, in the evaluation of NAP, it is important to make an adjustment for meals eaten away from home (or the proportion of total food use accounted for by food away from home) if the proportion of meals eaten away from home differed between the two years. Otherwise, if the number of meals away from home (for which no nutrient data are available) were greater in 1984 than in 1977, then NAP would appear to have reduced the

¹The sources for the nutritive values are B. Watt, and A. Merrill "Composition of Foods . . . Raw, Processed, Prepared, U.S. Department of Agriculture, Agricultural Handbook 8 (revised), 1963; the supplements to the Agricultural Handbook (8-1, 1976; 8-2, 1977; and 8-3, 1978); and M.L. Orr, "Pantothenic Acid, Vitamin B₆ and Vitamin B₁₂ in Foods," U.S. Department of Agriculture, Home Economic Research Report No. 36, 1969. Some values from these reports were revised by the Nutrient Data Research Branch of HNIS to reflect the current state of knowledge on nutritive values.

²In addition, neither nutrient availability nor nutrient intake are synonymous with nutritional status, since nutritional status depends not only on what is eaten but also on how the food is digested, metabolized, stored in the body, and excreted (Kennedy, 1983).

availability of nutrients to recipients regardless of whether any change occurred in the nutritive value of food used at home.

3. Measures of Household Composition

A consistent finding of previous research based on food use data similar to the data analyzed for this evaluation is that household size and composition have important effects on food expenditures and nutrient availability. Larger households and households with certain types of members (e.g., teenaged males) have been found to consume greater quantities of food, resulting in higher food expenditures and greater nutrient availability than is found for households of other sizes and/or composition. Three basic measures of household composition are used in research on food use data:

1. Household size
2. Household size in adult-male-equivalent persons
3. Household size in equivalent nutrition units

The first measure of composition--household size--is simply the number of persons in the household and is the easiest measure to use in analyses of food expenditures and nutrient availability. It is typically adjusted to 21-meal-at-home equivalent persons to account for differences in the number of meals eaten at home (21 meals-at-home in a week equals one person). One problem with household size and household size in 21-meal-at-home persons is that all household members are treated identically and thus, the age and sex of the household members are assumed unrelated to the amount of food use. This assumption is questionable since it is likely that variations in either food expenditures or nutrient availability can be

attributed in part to the age and sex, as well as the number, of household members. For example, a household consisting of a woman and two children has different nutritional requirements (and hence, is likely to have different food expenditures) than a household of similar size with three adult males.

The second measure of composition--household size in adult-male-equivalent persons--adjusts actual household size for the age and sex of the household members. The adjustment procedure weights each household member by the nutritional requirements of that member relative to the nutritional requirements of an adult male aged 23-50.¹ The sum of these weights gives household size in adult-male-equivalent persons. For example, consider the following household with a male and female head each aged 30, a boy aged 15, and a girl aged 12:

Household Member	Requirements for Food Energy (Kilocalories)	Relative Needs
Male, aged 30	2700	1.00
Female, aged 30	2000	.74
Male, aged 15	2800	1.04
Female, aged 12	2200	<u>.81</u>
Household size in adult- male-equivalent persons		3.59

¹These requirements are obtained from the 1980 Recommended Dietary Allowances (RDA), which were determined by the National Research Council of the National Academy of Sciences. Note that the 1980 RDA are used for both the 1977 and 1984 data.

The number of adult-male-equivalent persons in this household, based on the relative needs of the household members for food energy, is 3.59.

The final measure of composition--household size in equivalent nutrition units--is the number of adult equivalent males in the household eating meals from the household food supplies. It adjusts actual household size for both the age-sex composition of the family members and the proportion of meals eaten away from home. Continuing with the previous example, suppose the male head ate two-thirds of his weekly meals at home and the other household members ate all their meals at home:

Household Member	Relative Needs		Proportion of Meals Eaten at Home		Equivalent Nutrition Units
Male, aged 30	1.00	x	.67	=	.67
Female, aged 30	.74	x	1.00	=	.74
Male, aged 15	1.04	x	1.00	=	1.04
Female, aged 12	.81	x	1.00	=	<u>.81</u>
Household size in equivalent nutrition units					3.26

Household size in equivalent nutrition units for this hypothetical household, based on the relative needs for food energy, is 3.26 persons.

B. HOUSEHOLD CHARACTERISTICS

An important component of the evaluation of the effect of NAP on food expenditures and nutrient availability is a detailed descriptive analysis of low income households in Puerto Rico before and after the

replacement of the FSP with a cash assistance program. This analysis serves two purposes:

1. To provide comprehensive demographic and socioeconomic profiles of all households and program participant households in Puerto Rico before and after the introduction of NAP, and
2. To identify changes in background factors that may affect food expenditures and nutrient availability and which need to be considered in the statistical analysis of the relative impacts of cash and coupons.

The descriptive analysis of this section addresses these objectives by presenting data on the socioeconomic, demographic, and food purchasing/preparation characteristics of all households and program participant households in 1977 and 1984. In making comparisons between program participant households under the FSP and NAP, it is important to note that the program eligibility requirements were stricter under NAP, resulting in the loss of eligibility for some former FSP households. In order to provide a comparison group for the 1984 NAP participants that, at least partially, controls for these changes in the eligibility criteria between 1977 and 1984, the 1977 FSP participant households have been separated into those which would be eligible for participation under the 1984 NAP rules (adjusted for inflation) and those which would be ineligible. The first group, the NAP-eligible participants, provides the 1977 counterpart for the NAP participants in 1984, while the second group, the NAP-ineligible participants, provides an overview of the households made ineligible for assistance under the stricter eligibility rules of NAP.

1. Household Size, Income, and Participation in Food Assistance Programs

The first descriptive profile of Puerto Rico households includes information on household size, income, and participation in food assistance programs.

Household Size. Between 1977 and 1984, average household size in Puerto Rico dropped from nearly 4 members to approximately 3.7 members, as shown in Table II.1.¹ Average household size for program participant households also dropped, although the 1977 FSP and 1984 NAP participant households were on average .5 members larger than the typical households of their respective years. The drop in the average size of program participant households occurred despite the fact that the households of the NAP-eligible participants in 1977 tended to be larger than those of the NAP-ineligible participants. Average household size was 4.6 for NAP-eligible participants, compared to 4.2 for those households made ineligible under NAP.

The difference across time in average household size and the larger average size of program participant households persist when household size is adjusted for meals eaten away from home, for adult male equivalents, and for equivalent nutrition units. That is, average household size in 21-meal-at-home persons, in adult male equivalents, and in equivalent nutrition units were all higher in 1977 than in 1984 and, within each year,

¹The estimates presented in this volume differ for some characteristics, including household size, program participation and income, from those reported in Volume I. The estimates in this volume are based exclusively on the 1977 and 1984 household survey data, while the Volume I estimates were based on administrative data, census data, and other sources. Presumably, the survey estimates differ from the other sources because of sampling error, other measurement error, possible misreporting, and differences in concepts and definitions.

TABLE II.1
SELECTED CHARACTERISTICS OF HOUSEHOLDS IN PUERTO RICO, 1977 AND 1984:
HOUSEHOLD SIZE, INCOME, AND PARTICIPATION IN FOOD ASSISTANCE PROGRAMS
(means, except as noted)

Household Characteristic	1977				1984	
	All Households	FSP Participants			All Households	NAP Participants
		All	NAP Eligible	NAP Ineligible		
Household Size (persons)	3.98	4.51	4.55	4.23	3.66	4.15
Normalized Household Size (21-Meal-at-Home-Person- Equivalents)	3.79	4.30	4.35	3.92	3.41	3.89
Household Size in Adult Male Equivalents	3.40	3.80	3.82	3.62	3.16	3.52
Household Size in Equivalent Nutrition Units (21-Meal-at- Home-Adult-Male-Equivalents)	3.07	3.49	3.52	3.18	2.76	3.13
Number of Children Aged 18 or Younger	1.63	2.19	2.25	1.69	1.29	1.79
Number of Adults Aged 19 or Older	2.35	2.32	2.30	2.54	2.38	2.36
Household Cash Income (\$/week) ^a	162.82	81.69	66.36	200.58	190.01	73.08
Food Stamp Bonus Value or Value of NAP Benefits (\$/week) ^a	19.54	41.92	43.28	31.58	14.16	37.20
Household Cash Income Plus Value of Food Stamp Program or NAP Benefits (\$/week) ^a	182.37	123.63	109.63	232.16	204.17	110.28
Proportion of Households Participating in						
Food Stamp Program	.466	1.000	1.000	1.000	—	—
Nutrition Assistance Program	—	—	—	—	.381	1.000
WIC	.009	.016	.017	.007	.042	.096
School Lunch	.326	.440	.445	.399	.356	.485
School Breakfast	.060	.102	.105	.078	.084	.148
Sample Size	2,940	1,381	1,231	150	2,423	883

SOURCE: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

NOTES: All means and proportions are weighted; sample sizes are unweighted. Figures are computed using data from households with valid responses (i.e., non-missing) for that question or, in the case of income, valid responses and imputed values. Figures are presented for housekeeping households only (households with at least one person having 10 or more meals from household food supplies during the 7 days preceding the interview) with income per household member greater than \$5 per week in 1977 and \$7.15 per week in 1984. Standard deviations are provided in appendix Table E.2.

^aAll dollar values are in constant (1984) dollars.

A comparison of those households which would have been made ineligible for food assistance under NAP to the NAP-eligible participants indicates that there was a substantial difference in average household income. With the average weekly income of NAP-ineligible households (\$201) substantially greater than that of NAP-eligible households (and of all 1977 households), it is clear that the tighter eligibility requirements of NAP tended to eliminate the higher income households from the program.

Program Participation. Given the low average income levels in Puerto Rico, it is not surprising that approximately one-half of the households in Puerto Rico reported participating in the FSP in 1977. This high level of participation dropped following the implementation of NAP, with its tighter eligibility requirements. In 1984, program participation, as reported in the survey, was 38 percent of all households.

While participation in NAP fell from the levels of the former FSP, participation in other food assistance programs rose from 1977 to 1984, with FSP and NAP households comprising disproportionate shares of the participants in the other programs. In particular, 44 percent of 1977 FSP participant households and 49 percent of NAP participant households participated in the School Lunch Program, compared to 33 percent of all households in 1977 and 36 percent in 1984.

2. Social and Demographic Characteristics

The data on the social and demographic characteristics of Puerto Rico households, presented in Table II.2, suggest that the socioeconomic status of households in Puerto Rico improved somewhat between 1977 and 1984. Households in 1984 were more likely to have household heads with higher educational attainment, more likely to have household heads who were

TABLE II.2
SELECTED CHARACTERISTICS OF HOUSEHOLDS IN PUERTO RICO, 1977 AND 1984:
SOCIAL AND DEMOGRAPHIC CHARACTERISTICS
(percent of households)

Household Characteristic	1977				1984	
	All Households	FSP Participants			All Households	NAP Participants
		All	NAP Eligible	NAP Ineligible		
Male Head Present in Household	79.0	74.3	74.1	75.7	72.4	65.9
Age of Male Head						
Under 35 years	22.1	21.5	20.5	28.9	16.1	22.7
35 to 59 years	51.8	48.9	49.0	47.8	50.6	46.6
60 years and over	26.1	29.6	30.4	23.4	33.3	30.7
Education of Male Head						
None	5.2	9.1	9.9	3.4	4.3	7.4
Some elementary school	35.2	50.9	52.9	36.4	33.5	51.6
Completed elementary school	20.9	21.7	22.2	17.9	18.7	22.6
Completed at least high school	38.6	18.2	15.0	42.3	43.5	18.4
Male Head Employed	43.9	29.3	26.8	49.2	51.9	35.2
Female Head Present in Household	95.7	96.2	96.4	94.8	96.0	96.7
Age of Female Head						
Under 35 years	27.4	28.8	27.5	38.5	20.9	26.2
35 to 59 years	53.0	50.7	50.7	50.2	51.1	47.8
60 years and over	19.6	20.6	21.7	11.2	28.0	26.0
Education of Female Head						
None	7.9	12.8	14.1	2.6	6.8	10.2
Some elementary school	37.5	50.3	52.2	35.6	33.7	46.8
Completed elementary school	20.2	22.0	21.6	25.6	19.3	22.5
Completed at least high school	34.4	14.8	12.1	36.2	40.2	20.6
Female Head Employed	19.8	9.3	7.3	24.9	22.5	7.2
Race						
Black	11.2	13.8	13.9	13.4	10.7	12.6
Other	88.8	86.2	86.1	86.6	89.3	87.4
Geographic Location						
Central city	27.6	22.4	21.7	27.5	26.5	19.3
Suburban	17.3	11.6	10.4	20.9	16.6	11.6
Nonmetropolitan	55.1	66.0	67.8	51.6	56.9	69.1
Housing Arrangements						
Own home	75.6	71.0	70.7	73.3	76.9	67.7
Rent for cash	20.5	23.2	23.2	22.9	18.8	24.4
Occupy without rent	3.9	5.9	6.1	3.8	4.3	7.9
Sample Size	2,940	1,381	1,231	150	2,423	883

SOURCE: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

NOTES: All percents are unweighted; sample sizes are unweighted. Figures are computed using data from households with

valid responses (i.e., non-missing) for that question. Figures are presented for housekeeping households only (households with at least one person having 10 or more meals from household food supplies during the 7 days preceding the interview) with income per household member greater than \$5 per week in 1977 and \$7.15 per week in 1984.

employed, and more likely to own their own home than were households in 1977. However, households in 1984 were also more likely to be headed by a single female than were their 1977 counterparts. In terms of race and geographic location, the 1977 and 1984 households were very similar.

In comparing the social and demographic characteristics of NAP-eligible participants between 1977 and 1984, much the same pattern emerges, although at a lower socioeconomic status than was true for households in general. The 1984 NAP participant households were more likely to have household heads with higher educational attainment, more likely to have male heads who were employed (female heads were equally likely to be employed in 1977 and 1984), and more likely to be headed by a single female than were the 1977 NAP-eligible participants. The two groups of participants were very similar in terms of the other socioeconomic characteristics.

The socioeconomic status of the participating households who were not eligible for NAP in 1977 was consistently higher than that of the NAP-eligible participants. Thus, the tighter eligibility requirements of NAP appear to have targeted the food assistance benefits to those households with the lowest socioeconomic attainment.

3. Food Purchasing and Preparation

With respect to food purchasing and preparation, there appears to be little difference across all households and program participant households in 1977 and 1984 as to the person usually responsible for meal planning, shopping, and preparation. As shown in Table II.3, in the

TABLE II.3

SELECTED CHARACTERISTICS OF HOUSEHOLDS IN PUERTO RICO, 1977 AND 1984:
FOOD PURCHASING AND PREPARATION
(percent of households)

Household Characteristic	1977				1984	
	All Households	FSP Participants			All Households	NAP Participants
		All	NAP Eligible	NAP Ineligible		
Female Head Meal Planner	89.7	89.7	89.7	89.9	88.9	89.6
Female Head Meal Preparer	88.6	88.4	88.4	88.5	87.2	88.3
Female Head Food Shopper	73.2	71.7	70.8	78.1	72.2	72.9
Major Shopping Frequency						
More than weekly	10.1	8.4	8.1	10.3	7.5	4.7
Weekly	32.7	27.1	26.9	28.1	21.7	13.0
Every other week	27.8	25.4	25.0	27.8	26.1	18.2
Monthly or less than monthly	28.1	38.4	39.0	33.8	40.8	61.3
Never	1.3	0.9	1.0	0	3.9	2.8
Kind of Store for Major Shopping						
Supermarket	65.8	54.2	51.9	71.6	77.6	71.5
Small store	6.0	7.9	8.4	4.1	4.7	7.3
Open marketplace	0.4	0.4	0.5	0.4	0.6	0.3
Old-style market (colmado)	25.9	36.3	38.4	20.2	13.5	18.1
Other	2.0	1.2	0.9	3.6	3.5	2.8
Sample Size	2,940	1,381	1,231	150	2,423	883

SOURCE: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

NOTES: All percents are weighted; sample sizes are unweighted. Figures are computed using data from households with valid responses (i.e., non-missing) for that question. Figures are presented for housekeeping households only (households with at least one person having 10 or more meals from household food supplies during the 7 days preceding the interview) with income per household member greater than \$5 per week in 1977 and \$7.15 per week in 1984.

majority of households of all types across both years, this person was the female household head.¹

Households did differ, however, with respect to the frequency and location of shopping trips. Between 1977 and 1984 there was a marked decline in the frequency of major shopping trips for all households and for program participant households in particular. In 1977, 28 percent of all households and 39 percent of all NAP-eligible participant households shopped on a monthly or less-than-monthly basis. By 1984, the percent of all households shopping on a monthly or less-than-monthly basis had increased by 13 points and the percent of NAP participant households had increased by 22 points. The tendency of substantial proportions of NAP-eligible participants to shop on a relatively infrequent basis may reflect the timing of food expenditures relative to the receipt of monthly food assistance benefits.

The kind of store selected for major shopping trips changed somewhat for all households between 1977 and 1984 and changed considerably for NAP-eligible participant households. In 1984, the shopping patterns were similar for NAP participants and households as a whole. Supermarkets were the usual shopping place for both groups, with old-style markets ("colmados" or "mom and pop" markets) the next most common type of store. NAP participants were slightly less likely to shop in supermarkets and slightly more likely to shop in old-style markets. This pattern represents

¹This household characteristic has implications for the statistical analysis of food expenditures and nutrient availability. Since the female head is generally the household member making food expenditure decisions, variables controlling for her characteristics are included in the statistical analyses.

a shift from the shopping patterns of 1977 for both all households and NAP-eligible participant households. However, the shift away from old-style markets to supermarkets was much greater for the NAP-eligible participants. This shift in shopping locations between 1977 and 1984 is consistent with the focus group finding reported in Volume I that food coupons under the FSP could be exchanged most readily for cash or used to purchase ineligible items at "mom and pop" type markets. With the switch to cash issuance under NAP, participants would not need to rely as heavily on old-style markets and could switch to supermarkets, which the focus group members reported to be less expensive.

4. Summary of Findings

One of the purposes of the profile of household characteristics in Puerto Rico before and after the introduction of NAP was to identify changes in background factors which could affect food expenditures and nutrient availability and which need to be considered in the statistical analysis of the relative impacts of cash and coupons. There are several such changes which have been identified. First, there were substantial changes in household size and composition between 1977 and 1984, with the average size of households of NAP-eligible program participants declining by about .5 children. In addition, the overall income level of the NAP-eligible program participants was essentially unchanged over the period, although the components of that income changed considerably. Average weekly income rose by about 10 percent, while the average amount of weekly food assistance benefits fell by approximately 14 percent from 1977 to 1984. The net effect of these changes in income and food program benefits was to leave the average amount of income plus program benefits for NAP-

eligible program participants unchanged between 1977 and 1984. The final change between 1977 and 1984 to keep in mind when interpreting the findings of the statistical analysis is the major shift in shopping patterns by program participants. The shift away from old-style markets in 1977 to supermarkets in 1984 is consistent with prevalent trafficking under the FSP. To the extent that food stamps could be easily exchanged for cash, the cash issuance change would not be expected to lead to major reductions.

III. THE IMPACT OF NAP ON FOOD EXPENDITURES

This chapter provides estimates of the impact of NAP on total food expenditures and the money value of food used at home. First, a descriptive analysis of food expenditures shows the difference in food expenditures between NAP participants in 1984 and FSP participants in 1977. Second, statistical and simulation techniques are used to isolate the impact of NAP from the impacts of other factors on food expenditures.

The results of the analysis indicate that the change to cash issuance caused no reduction in total food expenditures of program participants and approximately a 2.4 percent reduction in the money value of food used at home. The restrictions on eligibility and benefits imposed by NAP resulted in a 2.3 percent decline in total food expenditures and a 2.0 percent decline in the money value of food used at home.

A. ANALYSIS STRATEGY

The evaluation of the effect of NAP on food expenditures in Puerto Rico consists of a comprehensive descriptive analysis and a formal statistical and simulation analysis. The descriptive analysis examines in detail four key measures of food expenditures collected in the two surveys:

1. Total food expenditures--which is the total money value of food used and, therefore, the sum of the following three categories
2. Money value of food used at home--which includes purchased food, home-produced food, and food received as a gift or payments
3. Amount spent on meals and snacks away from home
4. Subsidy value of school lunches and school breakfasts

Average values of these measures of food expenditures are presented for FSP participants in 1977 and NAP participants in 1984, as well as for all households in both years. Because the FSP participant and NAP participant groups are not strictly comparable (due to the more stringent eligibility limits under NAP), the food expenditure behavior of FSP participants in 1977 is also analyzed separately for NAP-eligible and NAP-ineligible participant households in 1977.

The descriptive analysis can provide only a first look at the difference in food expenditures between NAP participants and FSP participants, since it cannot fully isolate the effects of NAP from the effects of changes in factors unrelated to NAP on food expenditures. Nor can it partition the total effect of NAP into the effect of cash issuance versus the effect of restrictions on eligibility and benefits. It is these limitations, as well as the need to obtain the most accurate estimates of the impact of NAP on food expenditures, that motivates the second component of the analysis--the statistical analysis.

The statistical analysis of food expenditures focuses on total food expenditures and the money value of food used at home. Briefly, this analysis provides estimates of program impacts that are independent of other household characteristics that also affect food expenditures. In addition, the statistical analysis also takes into account the program participation decision of eligible households, by implicitly allowing the decision to participate in a food assistance program to be related to food expenditures. Simulation analysis uses the statistical estimates of the effect of NAP on food expenditures to quantify the changes in household

food expenditures attributable to cash issuance and to the restrictions of eligibility and benefits under NAP.

B. DESCRIPTIVE ANALYSIS OF FOOD EXPENDITURES

This section presents a descriptive analysis of food expenditures, which is essentially a comparison of average values for participant groups in 1977 and 1984. First, average values of food expenditures are presented for four groups of interest:

1. All households, 1977
2. FSP participants, 1977
 - a. eligible for NAP
 - b. ineligible for NAP
3. All households, 1984
4. NAP participants, 1984

These descriptive data provide an overview of food expenditures in 1977 and 1984. The observed changes in real food expenditures should not be interpreted as the effect of NAP since other factors changed between 1977 and 1984 in addition to the switch to NAP (in particular, inflation in the price of food). Sections C and D of this chapter provide estimates of the extent to which the changes in real food expenditures can be attributed to NAP.

As shown in Table III.1, total food expenditures (1984 dollars)¹ per person² per week by all Puerto Rico households was \$34.11 in 1977 and \$33.25 in 1984, a decline of 2.5 percent. For the participant groups, average total food expenditures per adult-male-equivalent person declined from \$30.50 in 1977 to \$28.15 in 1984, a decrease of 7.7 percent. However, this decline is only 6.7 percent if NAP-eligible participants in 1977 are compared to NAP participants in 1984.

The data in Table III.1 indicate that most of total food expenditures in both 1977 and 1984 is accounted for by food used at home. The average money value of food used at home also fell between 1977 and 1984 for all households and the participant groups. For NAP-eligible participants, the average money value of food used per equivalent nutrition unit declined \$1.78, or 6.0 percent, between 1977 and 1984. All of this decline is attributed to reductions in the value of purchased food, since the value of both home-produced food and food received as gift or pay increased between 1977 and 1984 for program participants (as well as for all households). In addition, as shown in Table III.1, the proportion of

¹ All food expenditure measures discussed in this report are expressed in constant (1984) dollars. The 1977 nominal values were inflated by a price index for food, calculated from the 1977 and 1984 data bases. The price index is 1.361, indicating that, on average, the price of food was 36.1 percent higher in 1984 than in 1977.

² For food away from home these are adult-male-equivalent persons. As discussed in Chapter II, the number of adult-male-equivalent persons in a household is obtained by weighting each household member by the nutritional requirements of that member relative to the nutritional requirements of an adult male aged 23-50, and by summing these weights. For the money value of food used at home, the appropriate household size scale is further adjusted to equivalent nutrition units, which differs from adult-male-equivalents in that the weights for each household member are the relative nutritional requirements multiplied by the proportion of meals eaten at home by that household member.

TABLE III.1

FOOD EXPENDITURES IN PUERTO RICO, 1977 AND 1984

Household Characteristic	1977				1984	
	All Households	FSP Participants		All Households	NAP Participants	
		All	NAP- Eligible			NAP- Ineligible
Total Food Expenditures per Adult Male Equivalent	\$34.11	\$30.50	\$30.16	\$32.95	\$33.25	\$28.15
Money Value of Food Used at Home per Equivalent Nutrition Unit	\$33.06	\$29.86	\$29.64	\$31.55	\$31.98	\$27.86
Purchased	\$31.38	\$28.28	\$28.02	\$30.33	\$29.44	\$25.41
Home-Produced	\$.73	\$.79	\$.82	\$.60	\$1.13	\$1.08
Gift or Pay	\$.94	\$.78	\$.80	\$.62	\$1.42	\$1.38
Expenditures on Food Away from Home per Adult Male Equivalent	\$3.59	\$1.70	\$1.39	\$4.08	\$4.29	\$1.53
Value of School Lunches per Adult Male Equivalent	\$.68	\$.94	\$.95	\$.90	\$.80	\$1.12
Value of School Breakfasts per Adult Male Equivalent	\$.05	\$.08	\$.09	\$.05	\$.09	\$.17
Proportion of Households with Home-Produced Food	.33	.36	.36	.34	.47	.51
Proportion of Households Receiving Food as Gift or Pay	.47	.43	.43	.43	.61	.61
Proportion of Meals Eaten Away From Home	.09	.07	.06	.11	.12	.09
Sample Size	2,940	1,381	1,231	150	2,423	883

SOURCE: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

NOTE: All means and proportions are weighted; sample sizes are unweighted. Figures are presented for house-keeping households only (households with at least one person having 10 or more meals from household food supplies during the 7 days preceding the interview) with income per household member greater than \$5 per week in 1977 and \$7.15 per week in 1984. Since total food expenditures and food away from home are expressed per adult-male-equivalent person, and food used at home is expressed per equivalent nutrition unit (i.e. 21-meal-at-home adult-male-equivalent person), detail does not add to total.

NAP-eligible participant households reporting the use of home-produced food increased from .36 in 1977 to .51 in 1984, and the proportion reporting the use of food received as gift or pay increased from .43 in 1977 to .61 in 1984. Apparently the decline in purchased food was partially offset by increases in the money value of home-produced food and food received as a gift or pay.

Expenditures on food away from home increased 19.5 percent for all Puerto Rico households between 1977 and 1984. This increase is much less for the participant groups and, indeed, when FSP participants in 1977 are compared to NAP participants in 1984, average expenditures on food away from home are less in 1984 than in 1977. However, this result is caused by the high average food expenditures of the NAP-ineligible participants in the FSP. When the comparison is restricted to NAP-eligible participants, average expenditures on food away from home increased \$.14 per adult-male-equivalent person per week between 1977 and 1984. In addition, as shown in the last row of Table III.1, the proportion of meals away from home increased from 6 percent in 1977 to 9 percent in 1984 for NAP-eligible participants.

The subsidy value of school lunches and school breakfasts increased between 1977 and 1984. For NAP-eligible participants, the subsidy value of school lunches increased from \$.95 to \$1.12 per adult male equivalent per week and the subsidy value of school breakfasts increased from \$.09 to \$.17 per adult male equivalent per week.

As shown in Chapter II, with respect to household demographic and socioeconomic characteristics, NAP-ineligible participants differ significantly from NAP-eligible participants. They also differ with respect to

food expenditures. The average values of total food expenditures, food used at home, purchased food, and expenditures on food away from home are higher for NAP-ineligible participants than for NAP-eligible participants in 1977. On the other hand, the average values of home-produced food, food received as a gift or pay, and school lunches and breakfasts are lower for NAP-ineligible participants than for NAP-eligible participants. Since purchased food and food eaten away from home are generally more expensive food sources than are home-produced food, food received as gifts or payments, and food from subsidized school meal programs, those findings are consistent with those in Chapter II that NAP-ineligible participants in 1977 had higher average incomes than NAP-eligible participants.

To summarize, total food expenditures of program participants declined from \$30.16 for NAP-eligible participants in 1977 (or from \$30.50 for all FSP participants in 1977) to \$28.15 for NAP participants in 1984. This decline occurred because of a decline in the money value of food purchased for use at home. All other food sources show increases between 1977 and 1984. In particular, both the proportion of participant households reporting the use of home-produced food or food received as a gift or pay, and the average money value of these foods, increased dramatically between 1977 and 1984. Expenditures on food eaten away from home also increased between 1977 and 1984 for the NAP-eligible participant groups, although this increase was less in percentage terms than either the increase in the money value of home-produced and gift/pay food or the subsidy value of school lunches and school breakfasts.

For several reasons, the decline in both total food expenditures and the money value of food used at home for program participants between

1977 and 1984 cannot necessarily be attributed to NAP. As described in Volume I of this report, the seven years between the two data collection efforts witnessed numerous changes in factors unrelated to NAP but which are potentially related to food expenditures. External factors of potential importance include demographic trends (e.g., smaller family sizes), business cycle fluctuations, inflation in food prices, increases in the labor force participation of women, migration patterns, the expansion of federal transfer programs, and trends in food production and distribution.¹ In addition, the purchase requirement for FSP participants was eliminated in January 1979. To the extent that the elimination of the purchase requirement (EPR) influenced food expenditures of program participants, simple 1977 to 1984 comparisons of food expenditures confound the effects of NAP and EPR.

C. STATISTICAL ANALYSIS OF FOOD EXPENDITURES

Given that other factors changed during the 1977-1984 period which can be expected to have influenced food expenditures, irrespective of the impact of NAP, statistical analysis is necessary to account adequately for the influences of those factors. This section presents the results of the

¹ One possible way to adjust the difference in food expenditures of program participants between 1977 and 1984 for the influence of factors not related to NAP is to examine the food expenditure changes of a comparison group over this time period. That is, the difference in the food expenditures of a comparison group not affected by NAP provides an indication of the changes in food expenditures that occurred to factors not related to NAP. If this change in food expenditures of the comparison group between 1977 and 1984 is subtracted from the change in food expenditures of program participants over this time period, the remaining difference provides some indication of the impact of NAP. Appendix B of this volume provides a more detailed discussion and the results of this type of analysis.

formal statistical analysis which isolates the effects of NAP from other potentially distorting influences. It begins with a brief review of previous studies of food expenditures. It then continues with a discussion of the methodology used in the analysis, followed by the main results.

1. Previous Studies of Food Expenditures

Before presenting this study's findings regarding food expenditures, it is useful to review briefly recent research on food expenditures among low income households. In these studies, statistical techniques were used to estimate the effects of money income and food stamps on household food expenditures. These estimates are usually presented in terms of the impact of a one dollar change in money income or food stamps on food expenditures, which is referred to as the "marginal propensity to consume food" (MPC) out of money income or food stamps.¹

Most of the previous estimates of the MPC out of money income are between .05 and .10, implying that household food expenditures would increase by 5 to 10 cents in response to an additional dollar of money income. In contrast, most estimates of the MPC out of food stamps are between .20 and .45, implying that household food expenditures would increase by 20 to 45 cents in response to an additional dollar's worth of food stamps. However, these estimates are of little value in assessing the impact of NAP because: (1) only one of the studies used data on Puerto Rico households (the remaining studies reviewed for this evaluation used U.S. mainland data); (2) most did not account adequately for differences of

¹Strictly speaking, marginal propensities to consume can be defined in relation to any commodity. In this report, MPC is assumed to refer only to food expenditures.

between food stamp participants and eligible nonparticipants; and (3) none of the studies examined the effects of cash food assistance benefits on food expenditures.¹

2. Methodology

Data from the 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey and the 1984 Puerto Rico Household Food Consumption Survey are used to estimate the effects of cash and coupon food assistance benefits on household food expenditures.² These surveys provide detailed information on food expenditures, household composition, income, and participation in food assistance programs. Data from program participants in 1977 and 1984 and FSP-eligible nonparticipants in 1977 and 1984 are used in the statistical analysis of food expenditures, resulting in analysis samples consisting of FSP-eligible households. Eligible nonparticipants are used in the analysis because: (1) the FSP and NAP participation decisions of eligible households are analyzed simultaneously with food expenditures; and (2) these households increase the precision with which the relationships between food expenditures and both program and household characteristics are estimated.

FSP-eligible households are used for the analysis in both 1977 and 1984, even though some of these households were not eligible to participate

¹Additional information on the existing studies of food expenditures is provided in Volume 1 of the Evaluation of the Nutrition Assistance Program in Puerto Rico, pp. IV-2 to IV-11.

²Supplementary analyses of food expenditures in Puerto Rico were conducted using time-series data and the descriptive data presented in Section B of this chapter. Findings from these analyses are reported in Appendix A and Appendix B respectively.

in NAP in 1984.¹ Two reasons exist for this. First, by using FSP-eligible households, the samples on which the analysis is based are comparable in 1977 and 1984. Second, FSP-eligible nonparticipants in 1984 are needed to quantify the impact of a more generous cash program with higher benefits and the more lenient income standards of the former Food Stamp Program on food expenditures.

Table III.2 reports the sample sizes for FSP participants and FSP-eligible nonparticipants in 1977 and NAP participants and FSP-eligible nonparticipants in 1984, as well as the average weekly food expenditures for each group. As indicated in this table, two alternative definitions of food expenditures are considered. The first is total food expenditures, which includes the money value of food used from home food supplies, the amount spent on meals and snacks away from home, and the subsidy value of school meal programs; the second is food used at home, which includes only the money value of food used from home food supplies.

The statistical analysis undertaken for this study is based on Full Information Maximum Likelihood (FIML) estimation. FIML differs from the descriptive analysis discussed in the previous section in that the estimates of the impact of cash versus coupons on food expenditures are independent of differences in the characteristics of households. For example, if households with greater benefits also have larger families, then FIML will provide estimates of the relationship between food expenditures and food assistance benefits that distinguish between the

¹FSP-eligible households in 1984 that were ineligible for NAP benefits were not included in the analysis of the NAP participation decision.

TABLE III.2

SAMPLE SIZES AND AVERAGE VALUES OF FOOD EXPENDITURE MEASURES
FOR STATISTICAL ANALYSIS OF FOOD EXPENDITURES

	1977		1984	
	Participants	FSP-Eligible Nonparticipants	Participants	FSP-Eligible Nonparticipants ^a
Sample Size	1,381	882	883	849
Average Total Food Expenditures ^b	\$30.50	\$33.52	\$28.15	\$32.29
Average Money Value of Food Used at Home ^c	\$29.86	\$32.62	\$27.86	\$31.59

SOURCES: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

NOTE: Dollar amounts are in constant (1984) dollars. All means are weighted. Sample sizes are unweighted.

^aThe sample of nonparticipants in 1984 consists of households that did not participate in NAP and that would have been eligible to participate in the 1977 FSP, after adjusting for inflation.

^b Weekly sum of the value of food used at home, amount spent on food away from home, and the subsidy value of school breakfasts and lunches. This variable has been scaled by adult-male-equivalent persons, based on the 1980 RDA for food energy.

^c Weekly money value of food used from home food supplies. This variable has been scaled by equivalent nutrition units, i.e., the number of adult-male-equivalent persons, based on the 1980 RDA for food energy, eating 21 meals at home per week.

effects of benefits and household size. The fact that FIML can adjust for observed differences in household characteristics, and thereby more closely identify the actual effect of food assistance benefits on food expenditures, makes it a powerful analysis tool.

An additional advantage of FIML over more traditional statistical procedures is that it can adjust the relationship between food expenditures and food assistance benefits for differences among households in the propensities to participate in a food assistance program. In particular, the fact that eligible nonparticipants choose not to participate in a food assistance program (the FSP in 1977 or NAP in 1984) suggests that they may differ systematically from participants in ways that may influence food expenditures. For example, participating households might spend more on food in the absence of a food assistance program than would eligible nonparticipants with similar observed characteristics. If these differences associated with the participation decision are ignored in the statistical analysis, the estimate of the impact of food assistance may be incorrect, since failure to adjust for differences in program participation will attribute all the difference in food expenditures between participants and eligible nonparticipants to the food assistance benefit, when in reality some difference in food expenditures would persist in the absence of the program. In effect, FIML analyzes the participation decision together with the determinants of food expenditures and recognizes that the participation decisions of eligible households may reflect important differences in food expenditure habits.

More specifically, FIML was used to estimate jointly an equation explaining food expenditures by FSP-eligible households and an equation

explaining program participation by FSP- or NAP-eligible households.^{1,2} In addition to food assistance benefits, the following household characteristics were considered important determinants of both total food expenditures and the money value of food used at home:

- o Weekly money income per adult male equivalent
- o Weekly subsidy value of school breakfasts per adult male equivalent
- o Weekly subsidy value of school lunches per adult male equivalent
- o Weekly value of home-produced food per adult male equivalent
- o Weekly value of food received as gift or pay per adult male equivalent
- o An indicator of whether a female head is present in the household
- o Race of the survey respondent

¹ A detailed and rigorous description of the exact food expenditure model is presented in Appendix C. The program participation equation was estimated for FSP eligibles in 1977 and NAP eligibles in 1984. The food expenditure equation was estimated for FSP eligibles in 1977 and those respondents to the 1984 survey who would have been eligible for the FSP, after adjusting for inflation, if the program had continued to exist in Puerto Rico. Thus, data on households that were FSP-eligible but NAP-ineligible in 1984 were included in the analysis of food expenditures but were not used in estimating the participation equation. Results from the participation analysis for 1984 were used to correct the expenditure analysis for differences between participants and nonparticipants for NAP eligibles only.

² The possibility was investigated that two food expenditure equations, one for program participants and one for nonparticipants, are required to analyze properly the behavior of FSP-eligible households in 1977 and 1984. Statistical tests based on the likelihood ratio revealed that two food expenditure equations do not provide a statistically significant increase in explanatory power over a single equation.

- o Number of adult-male-equivalent persons eating from the household food supplies
- o Number of guest meals per adult male equivalent

The average values of these characteristics in the 1977 and 1984 data files are presented in appendix Table C.1.

An important feature of the analysis of food expenditures is that household food expenditures, income, and program benefits are scaled by an adjusted measure of household size. Total food expenditures are scaled by adult-male-equivalent persons, based on the 1980 RDA for food energy; and the money value of food used at home is scaled by equivalent nutrition units, which is the number of adult-male-equivalent persons eating from the household food supplies. As discussed in Chapter II, these adjustments are necessary because variation among households in the age and sex composition of persons consuming food and in the number of meals eaten at home can substantially affect food expenditures.

3. Statistical Estimates and Implied Program Impacts

The discussion of the results of the analysis of food expenditures and program participation focuses primarily on estimates of the marginal propensities to consume food out of program benefits. Estimates of MPCs out of coupons (based on 1977 data) and cash benefits (based on 1984 data) are compared, and the implications of these estimates are examined. The results are presented separately for total food expenditures and for the money value of food used at home.

Total Food Expenditures. The estimates of the MPCs out of food assistance benefits are .21 for coupon benefits and .23 for cash

benefits.¹ The difference between these two estimates is not different from zero in a statistical sense, implying that the type of food assistance benefits (cash versus coupons) has no significant impact on total food expenditures.² The implications of these MPCs can be understood by comparing total food expenditures given cash benefits with total food expenditures given the same amount of coupon benefits. The average weekly cash benefit per adult male equivalent for NAP participants in 1984 was \$11.38. As discussed above, the marginal propensity to consume total food out of this benefit is estimated to be .23. If this benefit were issued in the form of coupons, however, the estimated MPC is .21. Thus, the switch to cash issuance is estimated to increase weekly total expenditures by only \$.23 per adult male equivalent $((.23-.21) \times \$11.38 = $.23)$.³ Comparing this increase of \$.23 to the average weekly value of total food expenditures per adult male equivalent of \$28.15 suggests virtually no change in total food expenditures due to cash issuance.

These results suggest that there is essentially no difference between the effects of food assistance benefits on total food expenditures in the FSP period (1977) and in the NAP period (1984). Effectively, the

¹Detailed results from the analysis of total food expenditures are presented in appendix Table C.3.

²In this report a result is referred to as statistically significant if it is significant at the .05 level or below.

³The MPCs presented in the text are rounded to two decimal points. The actual MPCs are .213 out of coupons and .226 out of cash benefits, resulting in a difference of .013. These estimates imply even a smaller increase in total food expenditures due to cash issuance--\$.15 per adult male equivalent per week $((.226 - .213) \times \$11.38 = $.15)$.

share of an additional dollar of benefits devoted to total food expenditures is the same in both periods--between 21 and 23 cents. However, although the type of food assistance benefits has no significant impact on food expenditures,¹ the existence of food assistance benefits (either as cash or coupons) does increase total food expenditures. For example, the MPC out of cash benefits of .23, coupled with the average weekly NAP benefit of \$11.38 per adult male equivalent, show that NAP benefits lead to a \$2.61 increase in total food expenditures per person per week.

Money Value of Food Used at Home. The estimates of the marginal propensity to consume food at home out of food assistance benefits are .27 for 1977 and .21 for 1984,² implying that an additional dollar's worth of coupons is estimated to result in a 6 cent greater increase in the money value of food used at home than an additional dollar of cash food benefits.³ This difference is not significant in a statistical sense;⁴

¹The t-ratio for the difference in estimated MPCs out of program benefits is 0.188, whereas the t-ratio for the estimated MPC out of coupons is 4.142 and the t-ratio for the estimated MPC out of NAP benefits is 4.764. A t-ratio of 1.960 implies statistical significance at the .05 level.

²These estimates of the marginal propensity to consume food at home out of food program benefits, as well as the estimates of the marginal propensity to consume total food out of food program benefits, are considerably lower than those reported for Puerto Rico by Blanciforti (1983), who also used the 1977 Puerto Rico household data. This difference is attributable to differences in sample definition between the two studies, differences in nutrition unit scales between the two studies, and the possibility of selection bias in the Blanciforti estimates which do not account for unobserved differences between program participants and eligible nonparticipants.

³Detailed results from the analysis of the money value of food used at home are presented in appendix Table C.5.

⁴The t-ratio for the difference is 0.852.

nevertheless, it is consistent with the fact that food coupons can be used only to purchase food for use at home, while cash benefits can be used to purchase not only food to be used at home but also food away from home and nonfood items. More specifically, the switch to cash issuance is estimated to reduce the money value of food used at home by \$.68, or approximately 2.4 percent of the average money value of food used at home of NAP participants $((.21-.27) \times \$11.38 = -\$.68)$.

Summary. The results of the statistical analysis show essentially no difference in the marginal propensities to consume out of coupons and cash benefits with respect to total food expenditures. For the money value of food used at home, the difference between the MPC out of cash benefits and the MPC out of coupons is .06, although this difference is not different from zero in a statistical sense. However, the findings of no change in total food expenditures and a small decline in the money value of food used at home due to cash issuance (approximately \$.68) suggest that households increased their expenditures on food away from home as a result of the switch to cash issuance under NAP. Because of the different household size scales used in the statistical analyses of total food expenditures (adult male equivalents) and money value of food used at home (equivalent nutrition units), the results of this research cannot be used to quantify the increase in expenditures on food away from home attributable to cash issuance. Nevertheless, this substitution of food away from home for food at home is expected to be minor for two reasons. First, the estimated reduction in the money value of food used at home due to cash issuance is not statistically different from zero, suggesting that any estimated increase in expenditures on food away from home is also not

statistically different from zero. Second, the descriptive data in Table III.1, which admittedly do not adjust for changes in factors other than NAP which occurred between 1977 and 1984, show that the amount spent on meals and snacks away from home increase only \$.14 per adult male equivalent per week between 1977 and 1984 for NAP-eligible program participants.

D. RESULTS OF THE ANALYSIS OF CASH ISSUANCE AND RESTRICTIONS ON ELIGIBILITY AND BENEFITS

The objective of this section is to examine in detail the implications of the statistical estimates of the marginal propensity to consume food out of cash and out of coupon benefits. Simulation analysis is used to assess the separate effects on total food expenditures and the money value of food used at home of cash issuance and restrictions on eligibility and benefits imposed by NAP. These separate effects are simulated for the year 1984 under two alternative programs: (1) a program equally restrictive as NAP, but which provides coupon benefits, and (2) a less restrictive cash program.

The remainder of this section consists of a brief explanation of simulation analysis, followed by the presentation of simulation results for NAP's effects on total food expenditures and the money value of food used at home. Estimates of the effects of both cash issuance and restrictions on eligibility and benefits are presented. The section concludes with a tabular summary of findings.

1. Explanation of Simulation Analysis

Simulation analysis is essentially an illustrative procedure. In the context of the Puerto Rico Nutrition Evaluation, it is a way of combining the statistical estimates of MPCs with information about NAP-

related program changes so as to demonstrate their implications for food expenditures (or the availability of nutrients, as discussed in Chapter IV). With simulation analysis, the statistical estimates are used to trace through the implied effects of NAP on the eligibility, participation, and food expenditures of individual households in the 1984 analysis file. By averaging the predicted food expenditure outcomes over participant households and comparing results under different sets of program rules, estimates of the average effects of program changes on the food expenditures of the population of participant households in Puerto Rico can be obtained.

The information on program impacts provided by simulation analysis is no greater than that provided by the statistical analysis; however, it is in a somewhat more easily understood form. In this particular application, simulation analysis uses MPC estimates to determine average levels of food expenditures under alternative sets of program rules. Thus, simulation analysis permits the discussion of NAP impacts to proceed in terms of changes in average food expenditures rather than changes in MPCs.

The separate effects of cash issuance and restrictions on eligibility and benefits can be estimated by comparing simulated food expenditures under NAP to simulated food expenditures under two hypothetical programs.¹ These programs, which have never been implemented in Puerto Rico or the

¹To obtain disaggregated estimates of the effects of NAP, it is necessary to consider one hypothetical program that is like NAP except that it provides the higher pre-NAP levels of benefits, and a second hypothetical program that is like NAP except that it provides benefits in the form of coupons. The necessity of considering food expenditure behavior under these hypothetical programs is not unique to simulation analysis, rather it is a necessary part of any effort to obtain disaggregated estimates of NAP's impacts.

mainland U.S., contain components of both the FSP and NAP. The two programs are:

1. A program with NAP eligibility rules that provides coupon benefits in amounts equal to those provided under NAP (henceforth referred to as the "Coupon Program")
2. A program with FSP eligibility rules that provides cash benefits in amounts equal to those that would have been provided under the FSP if it had continued to exist in Puerto Rico (henceforth referred to as the "Cash Program")

The estimated effect of cash issuance, independent of other NAP-related changes, can be obtained by comparing simulated food expenditures under NAP to simulated food expenditures under the "Coupon Program." A comparison of simulated food expenditures under NAP to those under the "Cash Program" gives the estimated effect of NAP's restrictions on eligibility and benefits. Step-by-step descriptions of the simulation analysis of total food expenditures under NAP and the two hypothetical programs are provided in appendix Tables C.10 and C.11.

2. Total Food Expenditures

As discussed in Section C of this chapter, the marginal propensities to consume total food out of coupons and cash benefits are estimated to be .21 and .23, respectively. Thus, the best estimate of the difference between the MPC out of coupons and the MPC out of cash is $-.02$, or approximately 2 cents per dollar of benefits. In a formal statistical sense this estimated difference is not significantly different from zero. In an absolute sense, the estimated difference implies that the switch from coupons to cash benefits had no meaningful effect on the total food expen-

ditures of FSP-participant Puerto Rico households. This finding is developed further below, through the presentation of simulation results.

The Effect of Cash Issuance. By comparing estimated total food expenditures under a hypothetical program that provides coupon benefits at NAP amounts to estimated expenditures under NAP, the effect of the cash issuance of food assistance benefits can be assessed independently of any NAP-related changes in benefit levels or eligibility rules.¹ This comparison can be made by referring to the top chart in Figure III.1, in which the second bar shows a \$28.90 average estimated weekly total food expenditure per adult male equivalent for households participating in the "Coupon Program."² The first bar in the chart shows that the average predicted expenditure for the same sample of households (participants in the "Coupon Program") under NAP is \$29.00. The difference in the average predicted weekly total food expenditure per adult male equivalent under the two programs is only 10 cents, which means that cash issuance is estimated to have virtually no effect on total food expenditures in Puerto Rico.

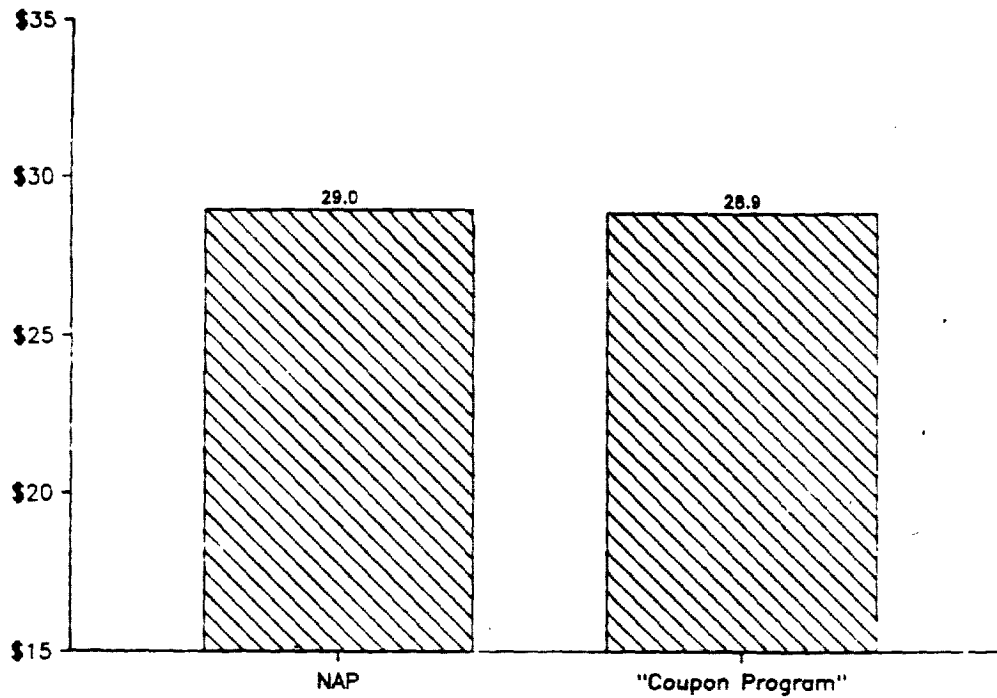
The Effect of Restrictions on Benefits and Eligibility. Estimates of the magnitudes of NAP-related changes in benefits and restrictions on

¹The simulation analysis implicitly assumes that the entire difference between the estimated MPC out of NAP benefits and the estimated MPC out of food coupons is attributable to cash issuance. The effect of coupons was estimated on data gathered prior to the elimination of the food stamp purchase requirement (EPR), so some of the difference may actually be due to EPR. However, the contribution of EPR is believed to be small. As part of this evaluation, a detailed statistical analysis of the 1977 data was conducted which rejected the hypothesis that the purchase requirement had an important effect on the food expenditures of food stamp participants. This analysis is discussed in Appendix D.

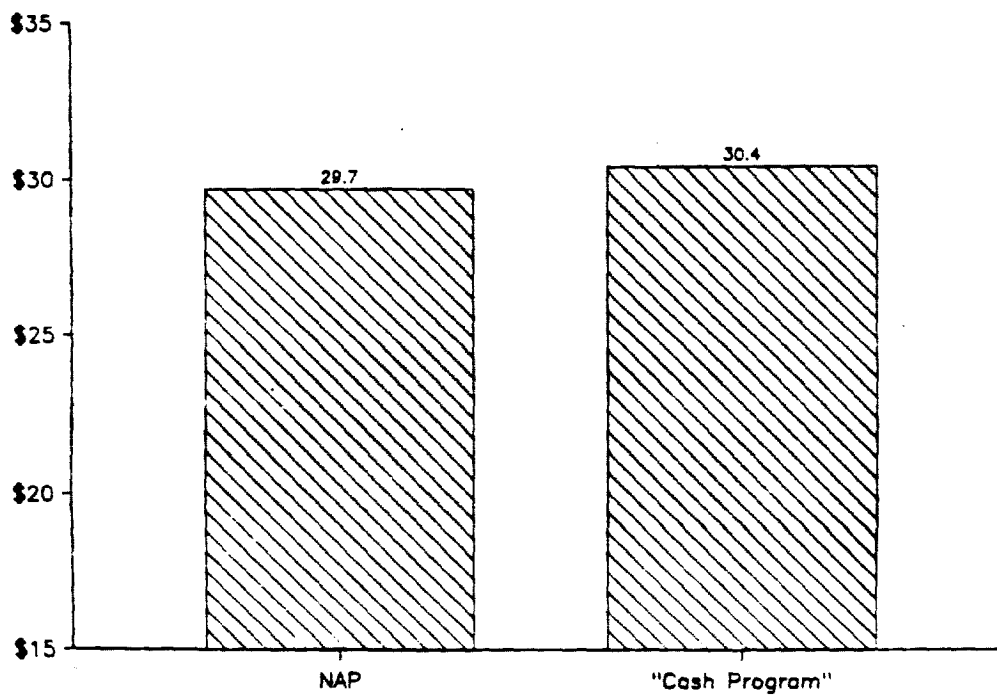
²Average simulated values of food expenditures may differ from average reported values for corresponding samples of households due to sampling error.

FIGURE III.1 SIMULATION RESULTS FOR WEEKLY TOTAL FOOD EXPENDITURES, 1984

Effect of Cash Issuance per Adult Male Equivalent



Effect of Restrictions on Eligibility and Benefits



eligibility are provided in Chapter I. Based on that discussion, the estimates of the critical program changes are as follows:

- o The average NAP benefit in the fourth quarter of 1984 was 16 percent smaller than the average benefit that would have been received under the former FSP. Virtually all of this reduction is attributable to the absence of indexing of the maximum NAP benefit.
- o The NAP income eligibility limits in the fourth quarter of 1984 were 40 percent smaller than the limits that would have been in effect under the former FSP.

Therefore, the average benefit of households continuing to receive food assistance benefits is lower under NAP than under the more generous FSP and some participants in the former program became ineligible under NAP.

Total food expenditures in 1984 were simulated under the hypothetical "Cash Program," which provides cash benefits in the larger FSP amounts and has the less restrictive FSP income eligibility limits. Results presented in the bottom chart in Figure III.1, show that the average predicted weekly total food expenditure per adult male equivalent for households participating in the "Cash Program" is \$30.40, as opposed to \$29.70 under NAP.¹ Thus, NAP's restrictions on eligibility and benefits are estimated to reduce the weekly total food expenditure of households participating in the more generous "Cash Program" by about \$.70 (2.3

¹Note that the target samples for the top and bottom charts in Figure III.1 are not the same. The target sample for the top chart consists of households in the 1984 data file that are predicted to participate in the "Coupon Program". The target sample for the bottom chart consists of households in the 1984 data file that are predicted to participate in the "Cash Program". This difference in target samples accounts for the small difference shown in the figure's charts in the average predicted food expenditure under NAP.

percent) per adult male equivalent as of the fourth quarter of calendar year 1984.

3. Money Value of Food Used at Home

As discussed in Chapter II, the nutritional information in the 1977 and 1984 data files is based on food used at home rather than on total food used. Therefore, to provide information on the nutritional impacts of NAP, it is necessary to investigate the effects of NAP on the money value of food used at home. This investigation begins with a review of the statistical estimates of the marginal propensity to consume food at home out of coupons and cash benefits and continues with simulation analyses of the effect of cash issuance and the effect of restrictions on eligibility and benefits.

As previously reported, the marginal propensity to consume food at home out of coupons is estimated to be .27, while the corresponding MPC out of cash benefits is estimated to be .21. The difference in the estimated MPCs of 6 cents per dollar of benefits is not different from zero statistically. However, a .06 difference in true values of the MPCs might imply that the cash issuance of food benefits had a sufficiently large negative effect on the money value of food used at home to be of concern. This question can be investigated with simulation analysis of the money value of food used at home, as discussed below.

The Effect of Cash Issuance. Using 1984 data on households that would have been eligible to participate in the FSP if it had continued to exist in Puerto Rico, the money value of food used at home was simulated under the current NAP and under the hypothetical "Coupon Program," following virtually the same procedures as for total food expenditures. Results

from these simulations are displayed in the top chart in Figure III.2. The second bar in this chart shows that, for households participating in the "Coupon Program," the average predicted weekly value of food used at home is \$29.30 per equivalent nutrition unit.¹ The first bar in the chart shows that, under NAP, the average predicted weekly money value of food used at home for the same sample of households is \$28.60 per equivalent nutrition unit. Thus, it appears that the transition from coupons to cash food assistance benefits in Puerto Rico (independent of the effects of changes in eligibility requirements and benefit levels) caused a reduction of \$.70 (2.4 percent) in the weekly money value of food used at home per equivalent nutrition unit.²

The Effect of Restrictions on Benefits and Eligibility. The second bar in the bottom chart in Figure III.2 shows that the average estimated weekly money value of food used at home by households participating in the "Cash Program" is \$29.90 per equivalent nutrition unit.³ These same households are estimated to spend \$29.30 on food at home under NAP. Thus, as of the fourth quarter of 1984, tighter NAP eligibility requirements and

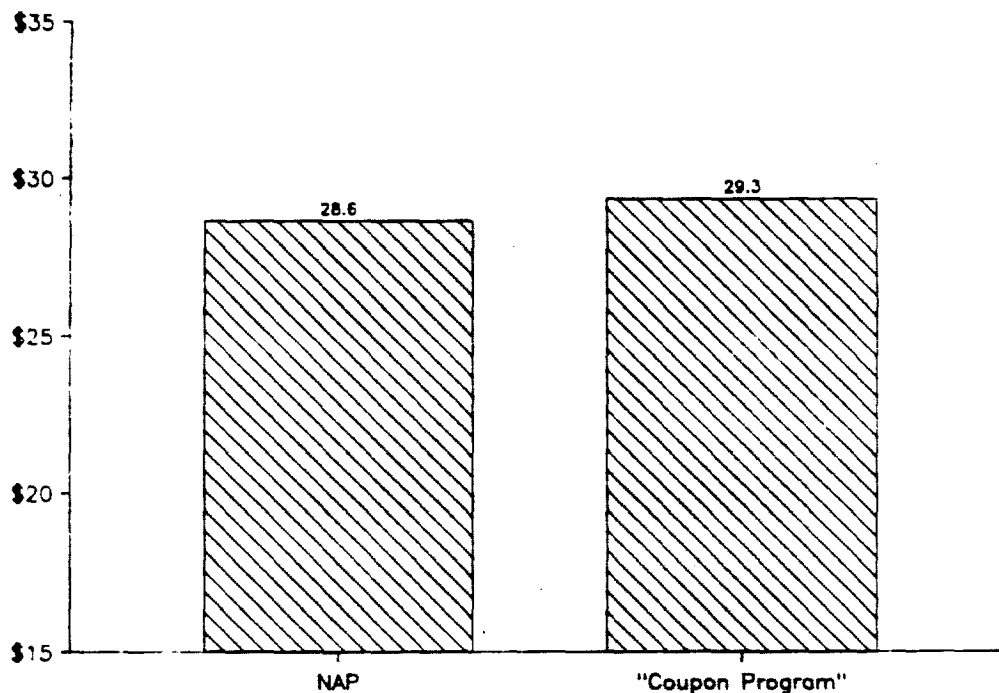
¹Recall that an equivalent nutrition unit is defined to be the equivalent, in terms of requirements for nutrients from food consumed at home, of an adult male who eats 21 meals per week from household food supplies.

²As discussed in Section C of this chapter, the near equivalence of the estimated MPCs for total food expenditures out of cash benefits and coupon benefits suggests that any reduction in the money value of food used

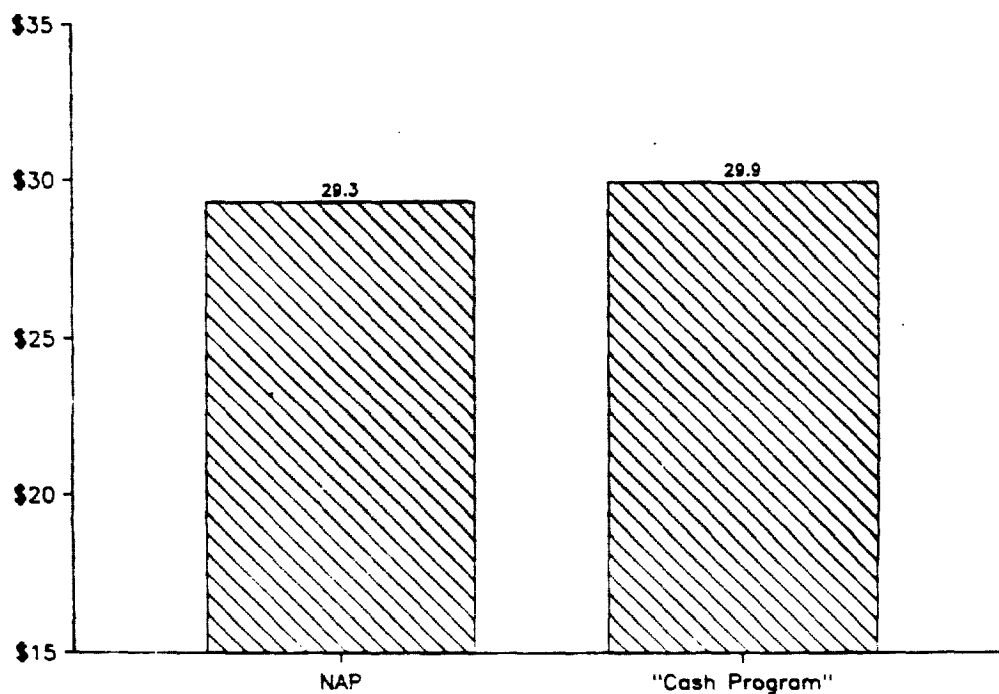
FIGURE III.2

SIMULATION RESULTS FOR WEEKLY VALUE OF FOOD USED AT HOME, 1984

Effect of Cash Issuance per Adult Male Equivalent



Effect of Restrictions on Eligibility and Benefits



the absence of indexation of NAP benefits are estimated to cause a reduction of \$.60 (2.0 percent) in the money value of food used at home.

4. Summary of Estimated NAP Effects on Food Expenditures

The simulation results that are illustrated in Figures III.1 and III.2 are presented in a tabular format in Table III.3. This table shows that cash issuance is estimated to have virtually no effect on total food expenditures and to reduce the money value of food used at home by 2.4 percent. Restrictions on eligibility and benefits are estimated to reduce total food expenditures by 2.3 percent and the money value of food used at home by 2.0 percent.

Differences between the samples upon which the two different types of program effects are estimated imply that it is not strictly correct to add the estimates together. However, the sample differences are not great, implying that the errors associated with adding the estimates together are not great. The sums of the estimated effect of cash issuance and the estimated effect of restrictions on eligibility and benefits are a 2.0 percent reduction in total food expenditures and a 4.4 percent reduction in the money value of food used at home.

E. CONCLUSIONS

The results of the analysis of food expenditures suggest that NAP caused small reductions in total food expenditures and in the money value of food used at home by households relative to the FSP.

The descriptive analysis shows that, after adjusting for inflation, the total food expenditures of NAP participants in 1984 were 6.7 percent lower than those of NAP-eligible participants in 1977. For these same

TABLE III.3

SIMULATION RESULTS FOR TOTAL FOOD EXPENDITURES
AND THE MONEY VALUE OF FOOD USED AT HOME

PANEL A: THE ESTIMATED EFFECTS OF CASH ISSUANCE

Type of Expenditure	Weekly Expenditures per Equivalent Person ^a			
	NAP (1)	"Coupon" Program (2)	Difference (1)-(2)	Percent Difference [(1)-(2)]/(2)
Total Food	\$29.00	\$28.90	+\$.10	+0.3%
Food at Home	\$28.60	\$29.30	-\$.70	-2.4%

PANEL B: THE ESTIMATED EFFECTS OF RESTRICTIONS
ON ELIGIBILITY AND BENEFITS

Type of Expenditure	Weekly Expenditures per Equivalent Person ^a			
	NAP (1)	"Cash" Program (2)	Difference (1)-(2)	Percent Difference [(1)-(2)]/(2)
Total Food	\$29.70	\$30.40	-\$.70	-2.3%
Food at Home	\$29.30	\$29.90	-\$.60	-2.0%

SOURCES: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey;
1984 Puerto Rico Household Food Consumption Survey.

^aFor total food the expenditure amounts are per equivalent adult male, whereas for food at home the expenditure amounts are per equivalent nutrition unit.

participant groups, the money value of food used at home was 6.0 percent lower in 1984. However, these declines cannot be attributed exclusively to NAP. Many factors unrelated to NAP but potentially related to food expenditures changed during the 1977-1984 period. The descriptive findings incorporate the effects of these changes as well as the effects of NAP.

The statistical analysis provides estimates of the separate effects of cash issuance and NAP's restrictions on eligibility and benefits on food expenditures. These estimates are independent of the effects of a number of other factors, such as money income, other food assistance programs, and household characteristics. The explicit accounting for these other factors enhances confidence that the statistical estimates accurately reflect the true effects of NAP. When incorporated in a simulation analysis of food expenditures, these estimates produce the following predictions of the effects of the program components of NAP:

- o Cash issuance of benefits, versus coupons, had no effect on total food expenditures and caused a decline in the money value of food used at home of approximately 2.4 percent.
- o Restrictions on eligibility and benefits caused total food expenditures and the money value of food used at home to fall by 2.3 percent and 2.0 percent respectively.

At the risk of some small error, these estimates of NAP's component effects can be added together to obtain estimates of NAP's full effect on food expenditures relative to the FSP. This yields an estimated reduction in total food expenditures of 2.0 percent and an estimated reduction in the money value of food used at home of 4.4 percent.

The descriptive findings of 6.7 and 6.0 percent reductions respectively, in total food expenditures and in the money value of food used at home, should not be regarded as estimates of NAP's total effect. This is because these findings reflect the effects on food expenditures of all factors that changed during the 1977-1984 period, including many factors unrelated to NAP. Consequently, the descriptive findings do not equal the estimates of NAP's total effects produced by the statistical and simulation analyses, that is, the estimates of a 2.0 percent reduction in total food expenditures and a 4.4 percent reduction in the money value of food used at home. The latter estimates can be regarded much more reliably as estimates of NAP's total effects because the multivariate procedures that generated these estimates adjust for the effects of 1977-1984 changes unrelated to NAP.

IV. THE IMPACT OF NAP ON NUTRIENT AVAILABILITY

As with the analysis of the impact of NAP on food expenditures, the examination of NAP's impact on nutrient availability includes two approaches. First, a descriptive analysis compares average values of nutrient availability for program participants in 1977 and 1984. Then, a combination of statistical and simulation techniques is used to estimate the impact of NAP on nutrient availability by adjusting more specifically for non-NAP influences.

The results of the statistical and simulation analyses of nutrient availability show small effects of NAP on diet quality. The effect of the switch from coupons to cash assistance leads to an increase in the percent of households failing to attain the Recommended Dietary Allowances (RDA) of 1.5 percentage points for food energy and of between .7 and 2.5 percentage points for the nutrients analyzed. The impact of restrictions on eligibility and benefits implemented by NAP is an increase in the percent of households failing to attain the RDA of 1.2 percentage points for food energy and between 1.4 and 2.4 percentage points for the nutrients examined.

An important caveat to these findings is that the nutrient availability data are based only on food used at home and not on total food use, as discussed in greater detail in Chapter II. Thus, the impacts of NAP summarized above and presented in this chapter refer only to the effects on the quality of at-home diets. This is particularly important given the findings in Chapter III that the switch from coupons to cash issuance had no impact on total food expenditures but resulted in a small reduction in the money value of food used at home (2.4 percent). It is not possible,

given the data constraints, to investigate the implications of no change in total food expenditures on nutrient availability.¹

A. ANALYSIS STRATEGY

The analysis of the effect of NAP on the diet quality of Puerto Rico households consists of a comprehensive descriptive analysis and a combined statistical and simulation analysis. The descriptive analysis provides an overview of the diet quality of all households and program participant households in 1977 and 1984. This is based on a series of tables that display four different measures of nutrient availability:

1. Average quantity (in pounds) of food used per 21-meal-at-home person in a week by the major food groups
2. Nutrient availability per dollar of food used at home
3. Nutritive value of food used at home per equivalent nutrition unit per day
4. Percentages of households meeting the 1980 Recommended Dietary Allowances (RDA)

In addition, the 1977 NAP-eligible and NAP-ineligible FSP participants are analyzed separately in order to have comparable NAP-eligible participant

¹ Previous studies have found that meals eaten away from home have about the same nutritive value as meals eaten at home (Kennedy et al., 1983). However, this result provides little information on the availability of nutrients per dollar of expenditures on food away from home. If the nutrient return per dollar is less for food away from home than for food at home, then a NAP-induced shift of consumption toward food away from home is likely to lead to reduced nutrient availability. It is important to reiterate, however, that the estimated differences in both total food expenditures and the money value of food used at home due to cash issuance are not different from zero in a statistical sense and hence, the effect of cash issuance on expenditures on food away from home is also essentially zero.

groups in 1977 and 1984 and to compare the diet quality of NAP-eligible and NAP-ineligible households.

The statistical and simulation analyses isolate the effects of NAP on nutrient availability from other household characteristics that also influence diet quality. In the statistical analysis, the relationships between the money value of food used at home and the availability of nutrients are estimated, with appropriate adjustments for other household characteristics affecting nutrient availability. These estimates are then used in the simulation analysis to estimate the separate effects of cash issuance and of restrictions on eligibility and benefits on the availability of nutrients from food used at home.

B. DESCRIPTIVE ANALYSIS OF NUTRIENT AVAILABILITY

This section presents a detailed descriptive analysis of nutrient availability in Puerto Rico. First, the nutrient availability data from the 1977 and 1984 Puerto Rico household food consumption surveys are briefly reviewed. This is followed by a description of nutrient availability in Puerto Rico in 1977 and 1984, with an emphasis on the differences between NAP participants in 1984 and NAP-eligible participants in 1977.

1. Nutrient Availability Data

Both the FSP and NAP share the common objective of improving the quality of low income households' diets. To investigate whether this objective is met, a variety of measures of food use and nutritional adequacy of household diets are analyzed using the 1977 and 1984 Puerto Rico food consumption data. These data contain measures of food used from

household food supplies over the period of a week and household availability of food energy and 11 nutrients derived from these foods.¹ It is important to reiterate that nutrient availability is not equivalent to nutrient intake; availability data generally overstate actual intake. Thus, nutrient availability data obtained from the household food use data should be interpreted with caution, in particular when comparing nutrient availability against standards for nutrient contents of an adequate diet (e.g., the RDA).

2. Nutrient Availability in 1977 and 1984

The descriptive data on nutrient availability suggest that the nutritional adequacy of the diets of all Puerto Rico households changed very little between 1977 and 1984. Most households in both years had diets - which satisfied the requirements for food energy and the 11 specific nutrients.

On the other hand, the diet quality of NAP-eligible participants generally increased between 1977 and 1984, although the quantities of food used and the availability of nutrients changed very little over this time period. For food energy and for 9 of the 11 nutrients examined, the percentage of households attaining the RDA increased between 1977 and 1984 for NAP-eligible participants.

¹The 11 nutrients include protein, vitamin A, thiamin, riboflavin, vitamin C, vitamin B₆, vitamin B₁₂, calcium, phosphorus, magnesium, and iron. In addition, data on the availability of fat, carbohydrate, and preformed niacin are also included in the data files but are not analyzed because of: (1) the absence of RDA for fat and carbohydrate and (2) the lack of a correspondence between the availability of preformed niacin and whether niacin requirements are satisfied.

Four measures of household nutrient availability are examined in this section to support these conclusions. They are:

1. Average quantity (in pounds) of food used per 21-meal-at-home person per week, by major food group
2. Nutrient availability per dollar of food used at home
3. Nutritive value of food used at home per equivalent nutrition unit per day
4. Percentage of households meeting the RDA

Some notes about these measures are in order. First, the quantity of food used by food group is given in converted quantities. For instance, the weights of cheese and milk are converted into their calcium equivalent weights, so that the converted quantity of cheese or milk is a relative measure of the calcium content of these food items rather than the raw weight. Second, nutrient availability per dollar of food used at home is expressed by dividing nutrient availability by the money value of food used at home in constant (1984) dollars. Third, the measure of household nutrient availability per equivalent nutrition unit (discussed in Chapter II) adjusts household nutrient availability for household size, household age and sex composition, and meals eaten away from home. Fourth, the percentage of households meeting the RDA is obtained by comparing the household nutrient availability with the recommended amount of nutrients for persons eating from the household food supplies, based on the 1980 RDA.

Quantity of Food Used by Food Group. As shown in Table IV.1, for all Puerto Rico households, the quantity of food used at home per person in a week differed only slightly between 1977 and 1984 for most of the food groups. Exceptions include: dairy products, for which the average

TABLE IV.1

**QUANTITY OF FOOD USED PER PERSON IN A WEEK
IN PUERTO RICO, 1977 AND 1984**

(Pounds Used)

Food Groups	1977				1984	
	All Households	FSP-Participants			All Households	NAP Participants
		All	NAP- Eligible	NAP- Ineligible		
Dairy Products	10.6	9.7	9.6	10.6	9.8	8.8
Meat, Poultry, Fish	5.0	4.5	4.5	4.7	4.9	4.4
Other Protein Foods	1.1	1.1	1.1	1.1	1.1	1.1
Vegetables	6.8	6.4	6.5	6.3	7.2	6.5
Fruits	2.8	2.2	2.1	2.7	3.7	2.6
Grain Products	3.8	4.2	4.3	3.9	4.1	4.7
Fats and Oils	1.1	1.1	1.1	1.0	1.0	1.0
Sugars, Syrup, Jelly	1.0	1.0	1.0	1.0	.9	.9
Soft Drinks, Punches	0.5	.4	.4	.5	.5	.4
Other Foods	0.6	.4	.4	.4	.5	.4
Sample Size	2,940	1,381	1,231	150	2,423	883

SOURCE: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

NOTE: Twenty-one meals at home in a week is equivalent to 1 person. All means are weighted; sample sizes are unweighted. Quantities reported are converted quantities. Figures are presented for housekeeping households only (household with at least one person having 10 or more meals from household food supplies during the 7 days preceding the interview) with income per household member greater than \$5 per week in 1977 and \$7.15 per week in 1984.

quantity used fell .8 of a pound; and vegetables, fruits, and grain products, for which the average quantity used increased over the seven year period. The largest increase for the total sample was in the use of fruits, which increased an average of .9 of a pound per person per week between 1977 and 1984.

The average quantities of food used changed very little for program participants between 1977 and 1984, with the exceptions of dairy products, fruits, and grain products. For NAP-eligible participants, the average quantity of dairy products used declined .8 of a pound per person per week between 1977 and 1984, while the average quantity of fruits and grain products used increased .4 and .5 of a pound, respectively. The quantity of vegetables used, which increased for all households between 1977 and 1984, was constant for NAP-eligible participants.

A comparison of the diets of NAP-ineligible and NAP-eligible participants in 1977 shows that NAP-ineligible participants used more dairy products, meats, and fruits and less vegetables and grain products than NAP-eligible participants. The use of the other major food groups differed very little between these two FSP participant groups.

Nutrient Availability per Dollar of Food Used at Home. Except for vitamin B₁₂, the return to a dollar of food used at home in terms of nutrient availability was consistently higher (or the same) in 1984 than in 1977 for all households, as depicted in Table IV.2. In addition, NAP participants in 1984 had higher availability of nutrients per dollar of food used at home than FSP participants in 1977 for most nutrients, again with the exception of vitamin B₁₂. Food program participants had higher

TABLE IV.2

NUTRIENT AVAILABILITY PER DOLLAR OF FOOD USED AT HOME
BY HOUSEHOLDS IN PUERTO RICO, 1977 AND 1984

Food Groups	1977				1984	
	All Households	FSP-Participants			All Households	NAP Participants
		All	NAP- Eligible	NAP- Ineligible		
Food Energy (Kcal)	995.9	1,086.3	1,096.5	1,006.4	1,049.5	1,180.0
Protein (g)	31.7	33.4	33.6	31.8	33.1	35.9
Calcium (mg)	349.7	364.9	364.5	359.6	353.7	378.8
Iron (mg)	6.6	7.3	7.4	6.6	7.2	8.3
Magnesium (mg)	134.5	144.4	145.8	133.2	145.5	159.5
Phosphorus (mg)	552.8	584.9	587.2	567.5	566.6	615.0
Vitamin A (IU)	1,736.4	1,673.8	1,675.5	1,660.6	1,816.6	1,811.7
Thiamin (mg)	.6	.7	.7	.6	.7	.8
Riboflavin (mg)	.7	.7	.8	.8	.7	.8
Vitamin B ₆ (mg)	.7	.7	.7	.7	.7	.8
Vitamin B ₁₂ (μg)	1.9	1.9	1.9	1.8	1.7	1.8
Vitamin C (mg)	41.8	41.5	41.4	42.1	54.0	54.3
Sample Size	2,940	1,381	1,231	150	2,423	883

SOURCE: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

NOTE: All means are weighted; sample sizes are unweighted. Money value of food used at home in 1977 was adjusted to be in 1984 dollars. Figures are presented for housekeeping households only (household with at least one person having 10 or more meals from household food supplies during the 7 days preceding the interview) with income per household member greater than \$5 per week in 1977 and \$7.15 per week in 1984.

availability of most nutrients per dollar of food used at home than households in general.

In 1977, NAP-ineligible participants generally had lower nutrient densities per dollar of food used at home than NAP-eligible participants. However, the returns per dollar of food used at home for riboflavin and vitamin B₆ are the same for both FSP participant groups, and the density of vitamin C per dollar of food used at home is slightly higher for NAP-ineligible than for NAP-eligible participants.

Two implications of these findings are interesting to note. First, the higher availability of nutrients per dollar of food used at home for food program participants relative to all households, and for 1977 NAP-eligible participants relative to NAP-ineligible participants, suggests that the nutrient return to a food dollar is higher for the lower income households. Second, the 1977 to 1984 comparisons show an increase over time in the efficiency with which food dollars are converted into nutrient availability. This increase in "nutrient efficiency" appears to characterize the nutrient behavior of all households and food program participants and, as discussed below, appears to be a major reason why nutrient availability and the percentage of households meeting the RDA was generally stable or increasing between 1977 and 1984 in spite of declining real food expenditures.

Nutritive Value of Food Used at Home Per Nutrition Unit. Table IV.3 presents the average nutritive value of food used at home per nutrition unit in 1977 and 1984. As a reference, the daily nutritional requirements for an adult male aged 23-50 are also given, based on the 1980 RDA.

TABLE IV.3

NUTRITIVE VALUE OF FOOD USED AT HOME PER NUTRITION UNIT
PER DAY IN PUERTO RICO, 1977 AND 1984

Food Groups	1980 RDA for an Adult Male, Aged 13-50	1977				1984	
		All Households	FSP Participants		NAP- Ineligible	All Households	NAP Participants
			All	NAP- Eligible			
Food Energy (Kcal)	2,700	4,500.5	4,469.3	4,480.0	4,386.5	4,541.9	4,510.6
Protein (g)	56	141.5	137.0	136.6	139.7	139.6	135.9
Calcium (mg)	800	1,186.4	1,102.3	1,094.8	1,160.7	1,166.2	1,078.9
Iron (mg)	10	18.3	18.1	18.3	16.8	19.4	19.3
Magnesium (mg)	350	563.1	553.5	554.2	548.1	576.2	564.5
Phosphorus (mg)	800	1,898.6	1,787.2	1,778.1	1,858.2	1,875.8	1,764.5
Vitamin A (IU)	5,000	7,905.7	6,970.5	6,908.8	7,949.1	7,788.2	6,974.1
Thiamin (mg)	1.4	2.7	2.7	2.8	2.7	2.8	2.9
Riboflavin (mg)	1.6	3.3	3.1	3.1	3.2	3.1	3.0
Vitamin B ₆ (mg)	2.2	2.8	2.7	2.7	2.8	3.0	2.8
Vitamin B ₁₂ (ug)	3.0	7.4	6.7	6.7	6.8	6.3	5.8
Vitamin C (mg)	60	168.4	149.7	148.4	159.1	204.9	183.1
Sample Size		2,940	1,381	1,231	150	2,423	883

SOURCE: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

NOTE: All means are weighted; sample sizes are unweighted. A nutrition unit is a 21-meal-at-home-adult-male-equivalent person, based upon the 1980 RDA for each nutrient. Figures are presented for housekeeping households only (household with at least one person having 10 or more meals from household food supplies during the 7 days preceding the interview) with income per household member greater than \$5 per week in 1977 and \$7.15 per week in 1984.

On average, Puerto Rico households used food that exceeded the RDA by a considerable margin (although it should be kept in mind that the availability of nutrients from food used may overstate actual nutrient intake). Focusing on NAP-eligible participants yields the following findings: small increases from 1977 to 1984 in the availability of food energy, magnesium, vitamin A, thiamin, and vitamin B₆ (less than 4 percent); larger increases in the availability of iron (5.5 percent) and vitamin C (23.3 percent); slight decreases in the availability of protein, calcium, phosphorus, and riboflavin (roughly between 1 and 2 percent); and a fairly large decrease in the availability of vitamin B₁₂ (13.4 percent). The largest difference for NAP-eligible participants, as well as for the total sample, is in the average availability of vitamin C per nutrition unit, which increased 23 percent for NAP-eligible participants between 1977 and 1984. This is primarily because the fortification of foods with vitamin C was more prevalent in 1984 than in 1977.

Percentage of Households Meeting the RDA. In contrast to the finding that the average availability of each nutrient was considerably higher than the RDA in both 1977 and 1984, the nutrient data also show that not all households had diets satisfying nutritional requirements. As shown in Table IV.4, the nutrients for which the fewest households met the RDA in both years were calcium, vitamin A, and vitamin B₆. For the other nutrients, the RDA were met by at least three-quarters of the total samples in both 1977 and 1984.

For NAP-eligible program participants, the percentage of households meeting the RDA for the specific nutrients and food energy generally increased (by various magnitudes) between 1977 and 1984. Two exceptions

TABLE IV.4

PERCENTAGE OF HOUSEHOLDS MEETING THE RECOMMENDED DIETARY
ALLOWANCES (1980) IN PUERTO RICO 1977 AND 1984

Food Groups	1977				1984	
	All Households	FSP-Participants			All Households	NAP Participants
		All	NAP- Eligible	NAP- Ineligible		
Food Energy	86.2	85.0	84.5	89.0	86.3	86.6
Protein	98.0	97.4	97.0	100.0	97.6	97.9
Calcium	74.7	69.2	68.0	78.5	73.0	68.8
Iron	84.6	83.4	83.3	84.1	86.9	88.3
Magnesium	84.2	82.8	82.6	84.6	83.6	84.6
Phosphorus	96.1	94.3	93.7	98.6	95.4	95.1
Vitamin A	61.5	52.5	52.1	55.5	63.6	54.4
Thiamin	91.7	92.4	92.2	94.2	91.0	93.1
Riboflavin	91.6	89.7	89.3	92.8	89.9	88.1
Vitamin B ₆	67.3	63.2	62.5	68.4	70.5	69.2
Vitamin B ₁₂	84.1	79.4	78.6	85.8	76.4	71.2
Vitamin C	86.3	82.7	81.7	90.6	90.0	88.5
Sample Size	2,940	1,381	1,231	150	2,423	883

SOURCE: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

NOTE: All percents are weighted; sample sizes are unweighted. Figures are presented for housekeeping households only (household with at least one person having 10 or more meals from household food supplies during the 7 days preceding the

to this finding are riboflavin, for which the percentage of NAP-eligible participants meeting the RDA declined slightly between 1977 and 1984 (1.2 percentage points), and vitamin B₁₂, for which the percentage meeting the RDA declined from 78.6 percent to 71.2 percent for NAP-eligible participants between 1977 and 1984.

Fairly substantial differences in the percentage of households meeting the RDA exist between NAP-eligible and NAP-ineligible participants in 1977. The percentage of households meeting the RDA for food energy and for the specific nutrients is consistently higher for NAP-ineligible participants in the FSP than for NAP-eligible participants. The differences in the percentage of households meeting the RDA between these two FSP-participant groups range from .8 percentage points for iron to 10.5 percentage points for calcium. For food energy and 5 of the 11 nutrients, the difference in the percentages attaining the RDA between NAP-ineligible and NAP-eligible participants in 1977 exceeds 4.5 percentage points.¹

3. Summary

The descriptive analysis of the measures of nutrient availability indicates that the average nutritive values of food used at home by FSP participants in 1977 (both NAP-eligible and NAP-ineligible participants)

¹This general finding of the difference in the percentage of households attaining the RDA between NAP-ineligible and NAP-eligible FSP participants is somewhat surprising given the lower nutrient density per dollar of food used at home for NAP-ineligibles compared to NAP-eligibles. It is possible that the higher percentages meeting the RDA for NAP-ineligible participants can be attributed to their higher use of dairy products, fruits, and meat and to the higher availability of calcium, phosphorus, vitamin A, and vitamin C, compared to NAP-eligible participants.

and NAP participants in 1984 were high and considerably above the RDA. For food energy and for 8 of the 11 nutrients examined, the RDA were met by over three-quarters of the NAP-eligible participants in 1977 and by over 70 percent of the NAP participants in 1984. Further, for the most part, the quantity of food used changed very little for NAP-eligible participants between 1977 and 1984 (the major exception being the decline in the use of dairy products).

However, the percentage of households meeting the RDA increased for NAP-eligible participants between 1977 and 1984 for most nutrients. This finding is somewhat surprising, given the decline in real food expenditures (food expenditures in 1984 dollars), the inflation in the price of food between 1977 and 1984 (as discussed in Chapter III), and only small changes in the quantities used of the major food groups. Apparently, the changes in quantities of food used which resulted in a reduction in real food expenditures must have occurred primarily within the major food groups (e.g., from meat to poultry), leaving the average quantities used of the aggregate food groups generally unchanged. In addition, participant households (as well as all Puerto Rico households) appeared to compensate for declining real food expenditures and price inflation by using foods in 1984 which were relatively more nutritious. Evidence for this conclusion comes from the Table IV.2 which shows a higher availability of nutrients per dollar of food used at home in 1984 than in 1977.

Finally, it is important to emphasize that the findings of this descriptive analysis provide an overview of diet quality in Puerto Rico and how it changed between 1977 and 1984. These findings do not necessarily imply anything about the impact of NAP on nutrient availability, since

other factors unrelated to NAP which may affect nutrient availability also changed between 1977 and 1984. In particular, the data presented in Table IV.2 indicate an increase in the efficiency of converting food dollars into nutrient availability over the seven year period.¹ Thus, even if the switch to NAP resulted in lower levels of nutrients, the increased efficiency of households over time in converting food dollars to nutrients may offset this, resulting in little or no change in the diet quality of participant households. The statistical analysis presented in the following section isolates the impact of NAP on nutrient availability, with appropriate adjustments for the other factors influencing diet quality.

C. STATISTICAL ANALYSIS OF NUTRIENT AVAILABILITY

The objective of the statistical and simulation analysis of nutrient availability is to assess the effects on the quality of diets of: (1) cash issuance of food assistance benefits, (2) NAP's restrictions on eligibility and benefits, and (3) the presence of a food assistance program. In this section, the broad analytical framework is described and the implications of key statistical estimates are highlighted. These estimates are then incorporated in a simulation analysis, the results of which are discussed in Section D.

Unlike the descriptive analysis, which examines food energy and all 11 nutrients, the statistical analysis focuses on the availability of food energy and five key nutrients: calcium, vitamin A, iron, vitamin B₆, and

¹It is possible that this increase in "nutrient efficiency" is also due to NAP. However, the fact that nutrient availability per dollar of food used at home is higher in 1984 than in 1977 for all households suggests that the effect is not solely attributable to NAP.

magnesium. These nutrients are chosen because of evidence that they are potentially low in the diets of Puerto Rico households. The evidence for possible low-level availabilities of calcium, vitamin A, and vitamin B₆ comes from Table IV.4, which shows these nutrients to be those for which the fewest households met RDA. Further evidence for potential low-level availabilities comes from the 1977 individual food intake data (as opposed to food use data) from Puerto Rico, which indicate that iron and magnesium are also potentially low in the diets of Puerto Rico households.¹

1. Methodology

The overall approach for analyzing the effects of NAP versus the FSP on the availability of nutrients presumes that food assistance benefits (cash or coupons) affect the availability of nutrients through food expenditures. That is, FSP or NAP benefits are presumed to increase food expenditures,² which in turn are believed to increase the availability of nutrients to recipient households. Within this framework, the impacts of the FSP and NAP on nutrient availability are obtained indirectly from the effect of food assistance benefits on the money value of food used at home and the money value of food used at home on nutrient availability.³ This analysis framework is represented diagrammatically in Figure IV.1.

¹A more detailed discussion of low-level nutrients in the diets of Puerto Rico households is presented in Volume 1 of the Evaluation of the Nutrition Assistance Program in Puerto Rico, pp. IV-13 through IV-15.

²The finding, reported in Chapter III, Section C, that one dollar in food assistance benefits causes the money value of food used at home to increase by 21 to 27 cents substantiates this assumption.

³Recall that the data on nutrient availability in the 1977 and 1984 files are based only on food used at home.

FIGURE IV.1

DIAGRAMATIC REPRESENTATION OF THE
STATISTICAL ANALYSIS OF NUTRIENT AVAILABILITY

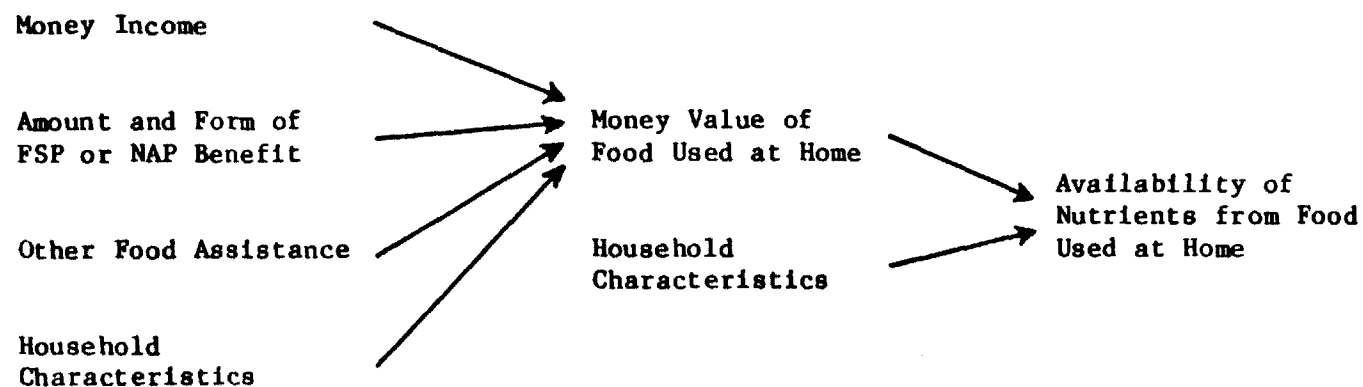


Figure IV.1 provides only a general view of the factors that are presumed to affect the availability of nutrients from food used at home. A detailed list of all such factors included in the analysis is as follows:

- o The money value of food used at home per equivalent nutrition unit¹
- o The race of the survey respondent
- o An indicator of whether the household has only a male head
- o An indicator of whether the household has only a female head
- o Indicators of the age of the female household head (or male head if no female head is present)²
- o An indicator of whether the female household head (or male head if no female head is present) completed high school
- o The employment status of the female head
- o The employment status of the male head
- o An indicator of whether the household owns its home

The average values of these factors in the 1977 and 1984 analysis files are provided in appendix Table C.7.

¹To avoid problems that might arise in the statistical analysis from the potential correlation of random disturbances affecting both the money value of food used at home and nutrient availability, the reported money value of food used at home is replaced by its predicted value based on the statistical estimates of the determinants of the money value of food used at home (see Chapter III, Section C).

²For variables referring only to one household head, the characteristics of the female head are included in the analysis because in most of the sample households she is responsible for purchasing food and preparing meals (see Table II.3).

A statistical procedure known as multivariate regression is used to estimate the relationships between these factors and the availability of calories and the previously identified five key nutrients. Multivariate regression adjusts for household characteristics that otherwise would contaminate the estimates of the impact of food expenditures (and hence, food assistance benefits) on nutrient availability.

2. Statistical Estimates and Implied Program Impacts

The principal finding from the regression analysis of nutrient availability is that the money value of food used at home has strong positive effects on the availability of nutrients per equivalent nutrition unit.¹ Regression estimates of the effects of a one dollar increase in the daily value of food used at home on nutrient availability are shown in Table IV.5.² These estimates are all statistically different from zero and they show that an additional dollar of food used at home provides roughly one-fifth to one-third of the adult male requirements for food energy and the five selected nutrients. The estimates also suggest that there was some improvement between 1977 and 1984 in the nutrient content per dollar of food used at home (1984 dollars), after adjusting for the effects of household characteristics. For example, as shown in Table IV.5, the estimated energy content of an additional dollar of food used at home increased from 690 kilocalories in 1977 to 781 kilocalories in 1984.

¹Recall that an equivalent nutrition unit is the equivalent, in terms of requirements for nutrients obtained from food consumed at home, of an adult male who eats 21 meals per week at home.

²Complete sets of regression estimates of the determinants of nutrient availability, including the effects of household characteristics, are provided in appendix Tables C.8 and C.9.

TABLE IV.5

ESTIMATED EFFECTS OF \$1 INCREASE IN FOOD USED AT
HOME ON THE AVAILABILITY OF FOOD ENERGY AND FIVE NUTRIENTS,
FOR FOOD-STAMP-ELIGIBLE PUERTO RICO HOUSEHOLDS IN 1977 AND 1984

	Food Energy (Kcal)	Vitamin B ₆ (mg)	Vitamin A (IU)	Magnesium (mg)	Calcium (mg)	Iron (mg)
Recommended Dietary Allowances (1980) for Adult Male	2,700	2.2	5,000	350	800	10
1977 Estimated Effect of \$1 of Food at Home per Equivalent Nutrition Unit ^a	690	0.40	1,330 ^b	94	196	3.2
1984 Estimated Effect of \$1 of Food at Home per Equivalent Nutrition Unit	781	0.52	1,470 ^b	106	197	3.5

SOURCES: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey;
1984 Puerto Rico Household Food Consumption Survey.

NOTE: Complete sets of regression estimates of the determinants of nutrient
availability are provided in appendix Tables C.8 and C.9.

^aThe 1977 money value of food used at home is measured in constant (1984) dollars.

^bThe regression estimates shown in appendix Tables C.8 and C.9 have been transformed
to show the effect of a \$1 increase in the value of food used at home on the
availability of vitamin A.

Estimated increases such as this in the nutrient content per dollar of food used at home between 1977 and 1984 do not necessarily imply that NAP caused the improvements.¹ They may instead be due to other factors that changed during the period.

The implications of the statistical estimates for the effects of NAP on the availability of nutrients can be examined by tracking the effects of NAP benefits through their impact on the money value of food used at home and then on nutrient availability. Two examples illustrate how the statistical estimates can be used to obtain estimates of the separate effects of cash issuance and NAP's restrictions on benefits on nutrient availability.

Cash Issuance. The average daily cash benefit for NAP participants in 1984 was \$1.63 per adult male equivalent, and the marginal propensity to consume food at home out of a cash benefit is estimated to be .21, versus .27 out of a coupon benefit. These estimates imply that cash issuance caused the average participant household to reduce its daily value of food used at home by \$.10 per equivalent nutrition unit:

Change in daily money value
of food used at home per = $(.21 - .27) \times \$1.63 = -\$.10$
equivalent nutrition unit

¹Although a comprehensive analysis of the 1977-84 increase in "nutrient efficiency" of food expenditures was not undertaken for this evaluation, multivariate regression was used to investigate whether nutrient efficiency increases as income and benefits, and hence, food expenditures, fall. No consistent significant evidence of such a relationship between nutrient efficiency and the level of food expenditures was found. This indicates that NAP's restrictions on eligibility and benefits, and the subsequent decline in food expenditures, were not responsible for the observed increase in the nutrient content per dollar of food used at home. However, these results provide no basis for determining whether cash issuance affected the nutrient efficiency of food expenditures.

Focusing here on food energy the effect of cash issuance on the daily availability of food energy for the average participant household in 1984 can be estimated by multiplying the \$.10 reduction in the money value of food used at home by the estimated effect of a one dollar increase in the money value of food used at home on the availability of food energy (see Table IV.5):

$$\begin{array}{l} \text{Change in daily availability} \\ \text{of food energy per} \\ \text{equivalent nutrition unit} \end{array} = -\$.10 \times 781 \text{ Kcal} = -78 \text{ Kcal}$$

This estimated reduction is 2.9 percent of the adult male RDA for food energy. Effects of cash issuance on the average participant household's availability of the five nutrients analyzed can be similarly estimated. As shown in appendix Table C.12, the estimated reductions in nutrient availability range from 2.3 to 3.5 percent of the adult male RDA.

Restrictions on Benefits. As discussed in Chapter I, benefits under the former FSP would have been approximately 16 percent higher in 1984 than NAP benefits. Thus, the average participant household would have received a daily benefit of approximately \$1.89 per adult male equivalent instead of the \$1.63 received under NAP. Using the .21 estimate of the marginal propensity to consume food at home out of cash benefits, the difference in average benefits implies a \$.05 reduction in the daily money value of food used at home:

$$\begin{array}{l} \text{Change in daily money value} \\ \text{of food used at home per} \\ \text{equivalent nutrition unit} \end{array} = .21 \times (\$1.63 - \$1.89) = -\$.05$$

This reduction in the money value of food used at home is estimated to reduce the daily availability of food energy by 39 kilocalories:

Change in daily availability
of food energy per
equivalent nutrition unit = $-\$.05 \times 781 \text{ Kcal} = -39 \text{ Kcal}$

This is 1.4 percent of the adult male RDA for food energy. Results for the five selected nutrients show reductions ranging from 1.4 to 1.8 percent of the adult male RDA, as shown in appendix Table C.13. Similar effects of NAP eligibility restrictions on the availability of the five nutrients analyzed are shown in appendix Table C.14.

D. RESULTS OF THE ANALYSIS OF NAP'S EFFECTS ON THE PERCENT OF HOUSEHOLDS FAILING TO ATTAIN RDA

In this section, simulation analysis is used to obtain estimates of the effects of cash issuance and restrictions on eligibility and benefits on the nutritional adequacy of diets. Simulation is a particularly useful analysis tool in this context because it brings together three pieces of the analysis that might otherwise remain fragmented: (1) the statistical analysis of the determinants of the money value of food used at home, especially the effects of food assistance benefits; (2) the statistical analysis of the determinants of nutrient availability, especially the effects of the money value of food used at home; and (3) estimates of the sizes of NAP-related changes in benefit levels and eligibility requirements. With simulation analysis, these pieces of information can be combined to produce estimates of nutrient availability under alternative program regulations and benefit levels and the nutritional adequacy of diets can be assessed by comparing nutrient availability to the RDA.

As illustrated previously in Figure IV.1, the structure of the nutrient availability statistical analysis is such that changes in the food assistance program affect nutrient availability only by affecting the money value of food used at home. This structure also underlies the simulation analysis of the effects of NAP on the nutrient availability. That is, the money value of food used at home is first estimated for each target household in the 1984 analysis file under NAP and two alternative food assistance programs. Then, based on those results, the availability of nutrients is estimated and compared to the RDA and average failure rates are computed.

1. The Effects of Cash Issuance and Restrictions
on Eligibility and Benefits

To assess the effects of cash issuance on diet quality, the estimated proportions of households participating in the hypothetical "Coupon Program" that fail to attain the RDA for food energy and the five selected nutrients are shown in Figure IV.2. Recall that the "Coupon Program" is assumed to provide NAP-level benefits in the form of coupons. Also shown in Figure IV.2 are the estimated proportions of these same households (participants in the "Coupon Program") that fail to attain the RDA under NAP. Failure to attain the RDA is somewhat more prevalent under NAP, ranging from 0.7 percentage points higher for calcium to 2.5 percentage points higher for vitamin B₆. These differences, the estimated effects of cash issuance, are attributable to the fact that the estimated marginal propensity to consume food at home out of cash benefits is smaller than the corresponding estimated MPC out of coupon benefits.

FIGURE IV.2

SIMULATION RESULTS FOR EFFECT OF CASH ISSUANCE ON NUTRIENT AVAILABILITY, 1984

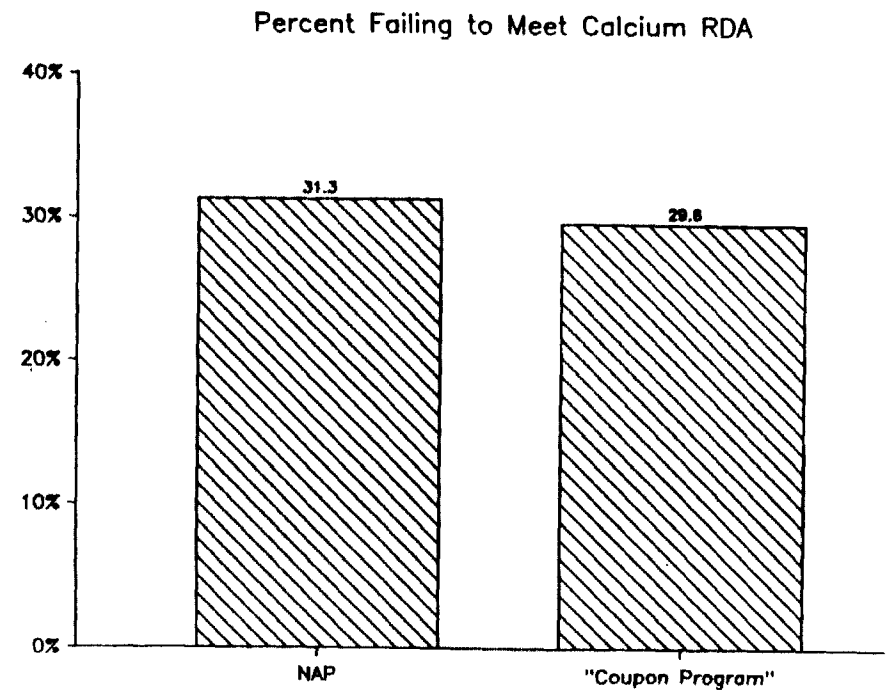
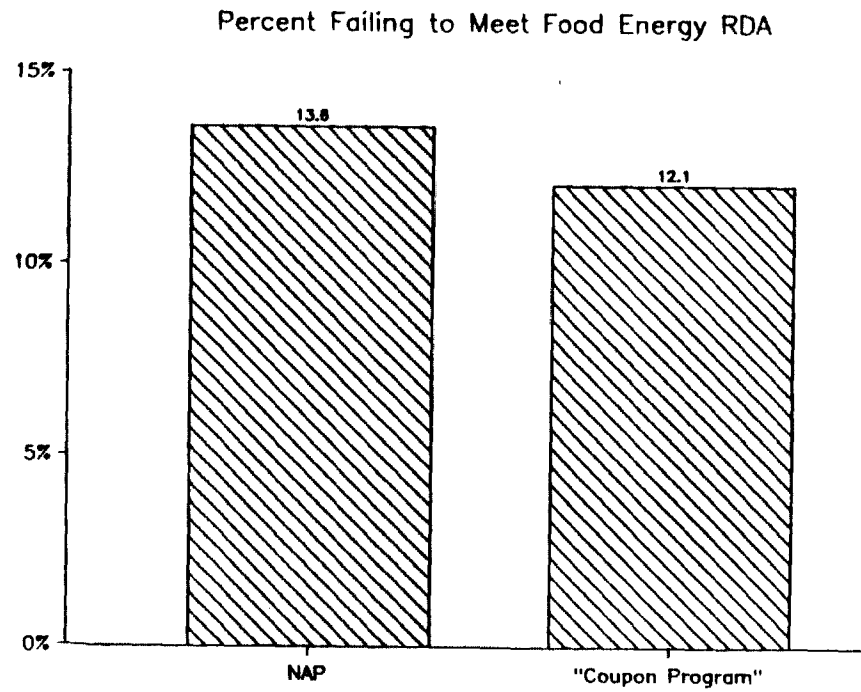


FIGURE IV.2 (CONTINUED)

SIMULATION RESULTS FOR EFFECT OF CASH ISSUANCE ON NUTRIENT AVAILABILITY, 1984

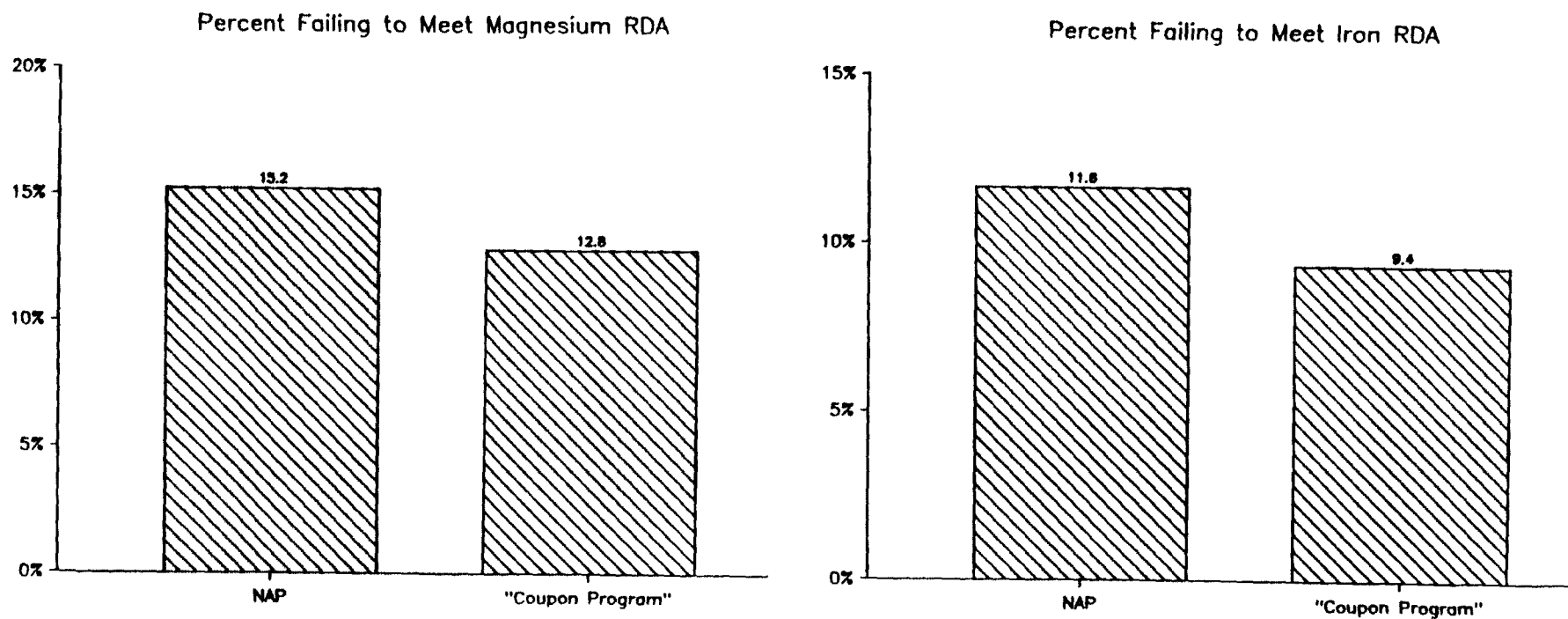
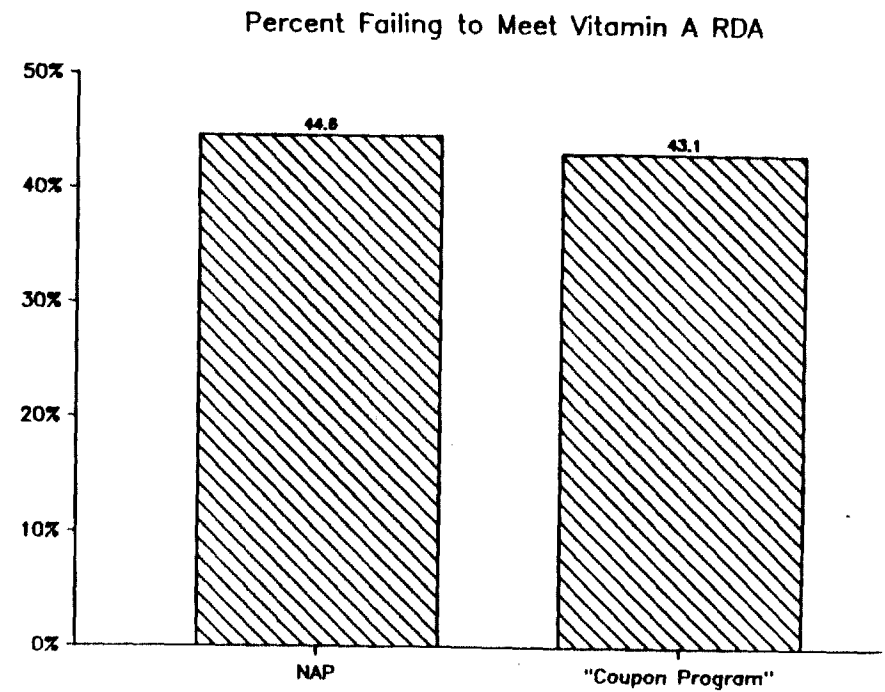
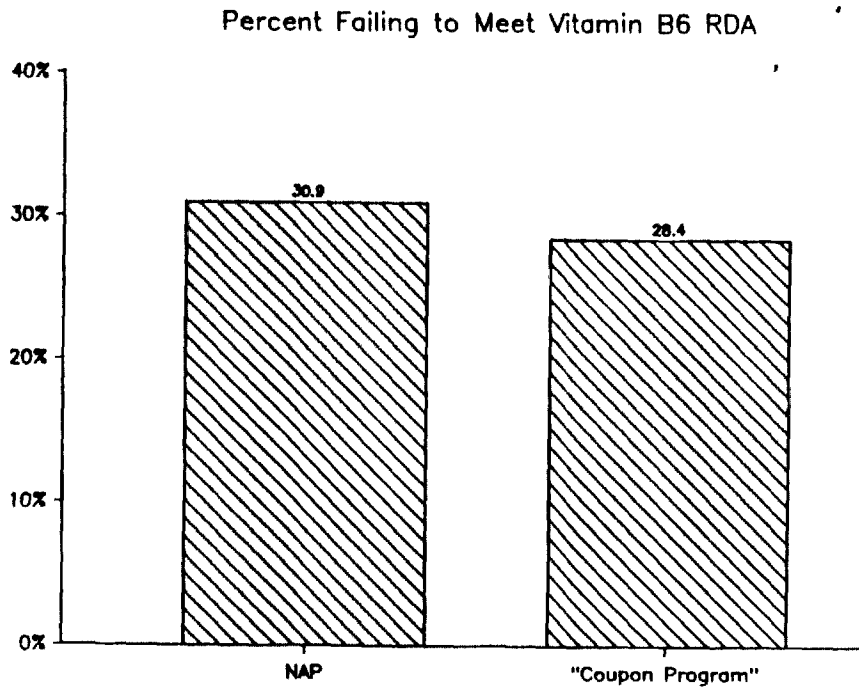


FIGURE IV.2 (CONTINUED)

SIMULATION RESULTS FOR EFFECT OF CASH ISSUANCE ON NUTRIENT AVAILABILITY, 1984



It must be stressed again that these findings are based only on food used at home. In effect, they answer the question: "What was the effect of cash issuance on the quality of at-home diets?" rather than the broader question: "What was the effect of cash issuance on the quality of total diets?" The second question cannot be answered fully because the 1977 and 1984 data sets provide no information on the nutrient content of food consumed away from home. The findings reported in Chapter III suggest that cash issuance had virtually no effect on total food expenditures. However, it does not necessarily follow that cash issuance had no effect on the total availability of nutrients. This would not be the case, for example, if nutrient availability per dollar were lower for food used away from home than for food used at home.¹

To assess the effects on diet quality of NAP's restrictions on eligibility and benefits, the estimated proportions of households participating in the hypothetical "Cash Program" that fail to attain the six RDA are shown in Figure IV.3.² The "Cash Program" is assumed to provide FSP-level benefits in the form of cash. Figure IV.3 also shows that somewhat higher estimated proportions of these same households fail to attain the RDA if the "Cash Program" is replaced by NAP. Estimates of failure rates under NAP range from 1.2 percentage points higher for food

¹Since the cost of food used away from home generally includes the costs of preparation and service as well as the cost of the basic food items, nutrient availability per dollar is likely to be lower for food used away from home than for food used at home.

²Note that the target samples for Figures IV.2 and IV.3 are not the same. The target sample for Figure IV.2 consists of households in the 1984 data file that are predicted to participate in the "Coupon Program." The target sample for Figure IV.3 consists of households in the 1984 data file that are predicted to participate in the "Cash Program."

FIGURE IV.3

SIMULATION RESULTS FOR EFFECT OF RESTRICTIONS ON ELIGIBILITY
AND BENEFITS ON NUTRIENT AVAILABILITY, 1984

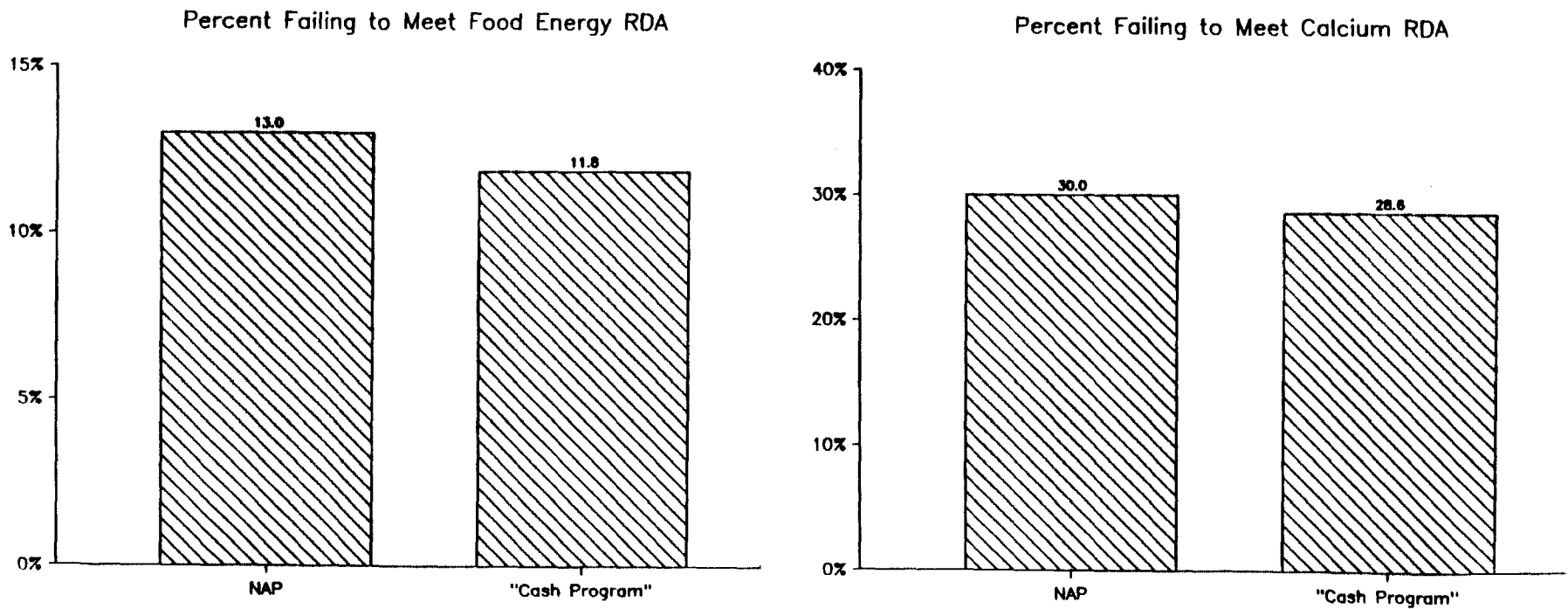


FIGURE IV.3 (CONTINUED)

SIMULATION RESULTS FOR EFFECT OF RESTRICTIONS ON ELIGIBILITY
AND BENEFITS ON NUTRIENT AVAILABILITY, 1984

IV-30

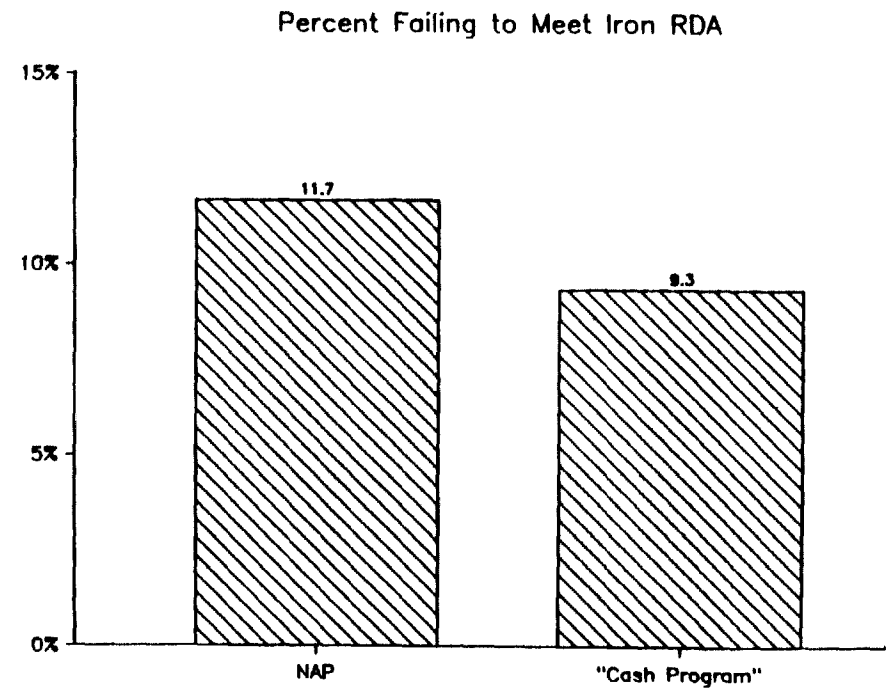
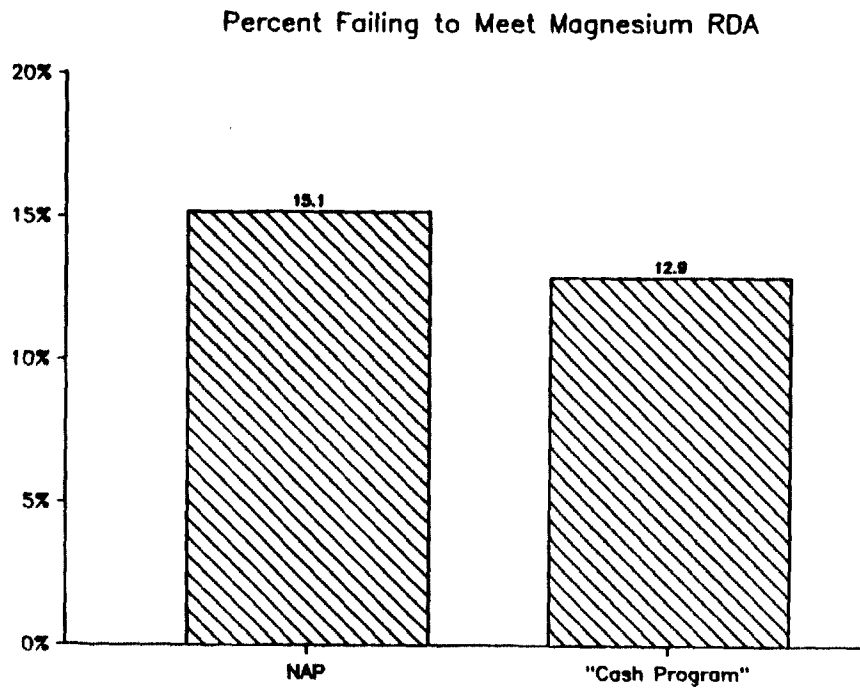
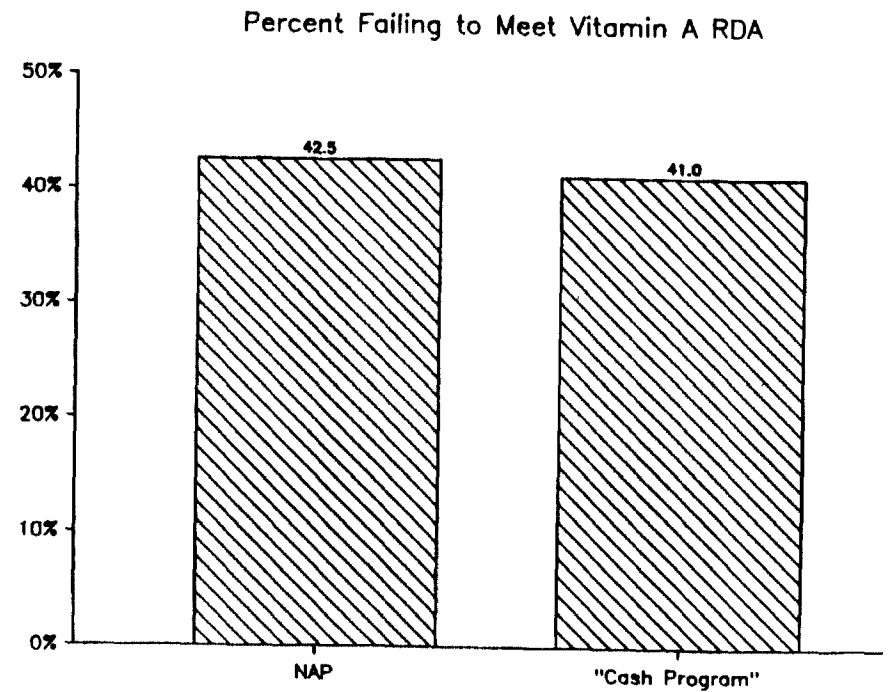
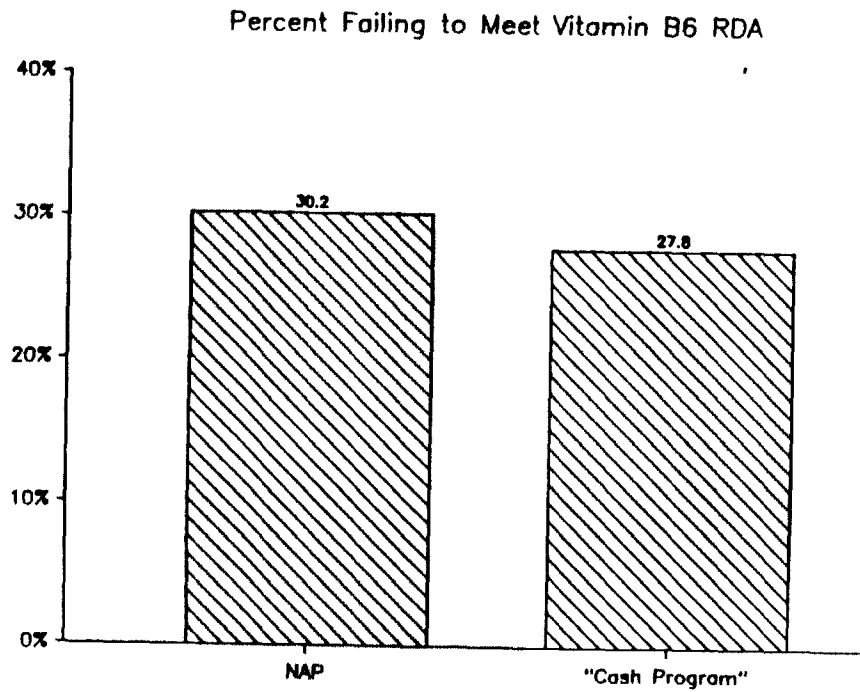


FIGURE IV.3 (CONTINUED)

SIMULATION RESULTS FOR EFFECT OF RESTRICTIONS ON ELIGIBILITY
AND BENEFITS ON NUTRIENT AVAILABILITY, 1984



energy to 2.4 percentage points higher for iron and vitamin B₆. Estimated failure rates are higher under NAP because benefits are smaller and eligibility requirements are more restrictive than under the "Cash Program."

The estimated increases in the proportions of households participating in (1) the "Coupon Program" and (2) the "Cash Program" that fail to attain the RDA for a selected nutrient upon the replacement of those programs by NAP should not be added together to obtain an estimate of NAP's full effect on the availability of that nutrient. The additivity problem goes beyond the rather small differences in the samples of participants in the "Coupon Program" and the "Cash Program." The increases in the proportions of households failing to attain the RDA are not additive because many of the same households would fall below the RDA as a consequence of either change. Adding the increases would double count these households and thus provide an overestimate of the full effect of NAP on nutrient availability.

The estimated negative effects of NAP on nutrient availability (relative to the "Coupon Program" and the "Cash Program") from the simulation analysis contrast with findings from the descriptive analysis presented in Section B. The descriptive results presented in Table IV.4 show that, for most nutrients, a slightly larger proportion of NAP participants in 1984 attained the RDA than did NAP-eligible participants in 1977. Contributing to this difference between the descriptive and simulation findings is the fact that the descriptive analysis compares 1977 NAP-eligible participants to 1984 NAP participants. In particular, nutrient availability per dollar of food used at home was generally higher in 1984 than in 1977, as shown in Tables IV.2 and IV.5. In the descriptive

analysis, this increase tends to offset or even dominate the negative effects of NAP. In the simulation analysis, nutrient availability per dollar of food used at home is held constant at 1984 levels for all three of the programs that are studied.

Little is known about the factors responsible for the 1977-1984 increase in nutrient availability per dollar of food used at home. Changes unrelated to NAP occurred during this period that probably contributed to the increase. These include a trend toward more home production of food, rising food prices, and a growing awareness of the need for nutritious diets. On the other hand, NAP participants may make more economical food purchasing decisions than FSP participants, in the sense of obtaining more nutrients per dollar, in order to have money left over to spend on nonfood items. It is likely that both cash issuance and trends unrelated to NAP contributed to the 1977-1984 improvement in nutrient availability per dollar of food used at home. If this is true, then the simulation results overstate the negative effects of cash issuance on nutrient availability. It therefore appears that the true effect of cash issuance on nutrient availability may be somewhat closer to zero than is shown by the simulation results in Figure IV.2. Note, however, that this discussion does not impinge on the accuracy of the simulation results for the effect on nutrient availability of NAP's restrictions on eligibility and benefits.

In addition, it is important to recall that the simulation estimates of increases in the proportions of households that fail to attain RDA as a consequence of cash issuance are based on a statistical estimate of the difference between the MPC out of coupons and the MPC out of cash that is not significantly different from zero. Thus, completely aside from

the question of changes in the availability of nutrients per dollar of food used at home, the simulated effects of cash issuance on nutrient availability are not significantly different from zero.

2. The Total Effect of NAP

Simulation analysis can also be used to assess NAP's total effect on nutrient availability. "Total effect" is used here not to refer to the combined effects of cash issuance and restrictions on eligibility and benefits, but rather to refer to the effect of NAP relative to the complete absence of a food assistance program targeted to the general low income population. The specific question to be answered is: "By how much does NAP improve the diets of participating households in terms of the likelihood of meeting the RDA for selected nutrients?" Table IV.6 shows that NAP is estimated to reduce the percent of participating households that fail to attain the RDA by between 5.0 percentage points (food energy) and 6.7 percentage points (magnesium). The magnitudes of these estimated effects indicate how much the current Nutrition Assistance Program improves the quality of diets of Puerto Rico households.

E. CONCLUSIONS

The results of the analysis of nutrient availability suggest that the diet quality of NAP participants is generally quite high. In addition, the nutritional adequacy of the diets of NAP-eligible participants generally increased between 1977 and 1984, as shown by the increasing proportion of NAP-eligible households attaining the RDA for all but two nutrients. Nevertheless, the results of the statistical and simulation analyses provide evidence that NAP resulted in a slight decline in diet quality.

TABLE IV.6

THE PREDICTED EFFECT OF NAP. RELATIVE TO NO FOOD
ASSISTANCE PROGRAM FOR THE GENERAL LOW-INCOME POPULATION, ON
THE PERCENT OF PUERTO RICO HOUSEHOLDS FAILING TO ATTAIN SELECTED RDA

Nutrient	Percent of NAP-Participant Households That Fail to Attain RDA		
	With No Program	With NAP	Difference
Food Energy	18.4	13.4	5.0
Calcium	37.4	30.9	6.5
Magnesium	21.5	14.8	6.7
Iron	16.7	11.6	5.1
Vitamin B ₆	37.1	30.6	6.5
Vitamin A	49.9	44.6	5.3

SOURCE: 1984 Puerto Rico Household Food Consumption Survey.

NOTE: Computed for all households predicted by a simulation analysis to participate in NAP.

The major results of the descriptive analysis show that, despite very few changes in the quantities of food used from the major food groups between 1977 and 1984, the percentage of NAP-eligible participant households attaining the RDA increased for most nutrients (the exceptions are riboflavin and vitamin B₁₂). Fairly substantial increases of five or more percentage points occurred for three of the nutrients (iron, vitamin B₆, and vitamin C) and smaller increases occurred for the remaining nutrients. In some ways, the finding of some increase in diet quality is surprising, given that real food expenditures (food expenditures in 1984 dollars) declined over this seven year period. Apparently, participant households (as well as all Puerto Rico households) compensated for declining real food expenditures by using foods which were relatively more nutritious.

Descriptive evidence for this conclusion comes from Table IV.2 which shows a higher availability of nutrients per dollar of food used at home in 1984 than in 1977.

The descriptive findings provide only an overview of the diet quality of participant households in 1977 and 1984. The effects of NAP on nutrient availability are not isolated from the effects of all other factors changing over the seven year period. In contrast, the statistical analysis of nutrient availability attempts to distinguish between the effects of NAP and the influences of other factors on diet quality.

The results of the statistical and simulation analyses of nutrient availability show small negative effects of NAP on diet quality. The effect of cash issuance is an increase in the percent of households failing to attain the RDA of 1.5 percentage points for food energy and of between .7 and 2.5 percentage points for the other nutrients examined. NAP's

restrictions on eligibility and benefits are estimated to have increased the percentage of households failing to meet the RDA by 1.2 percentage points for food energy and by between 1.4 and 2.4 percentage points for the other nutrients analyzed.

There are two important qualifications to the estimated increases in the percentages failing to attain the RDA due to cash issuance. First, these estimates are the maximum effects of cash issuance and would be even smaller if the increase between 1977 and 1984 in the efficiency with which food dollars are converted to nutrients is partly an effect of NAP. Second, the estimated effects of cash issuance on the percent of participants failing to attain the RDA are based on a difference in the marginal propensities to consume food at home out of coupons and cash benefits that is not different from zero in a statistical sense. Therefore, the estimated increases in the percent failing to meet the RDA are also not significantly different from zero.

REFERENCES

- Adrian, John, and Raymond Daniel. "Impact of Socioeconomic Factors on Consumption of Selected Food Nutrients in the United States." American Journal of Agricultural Economics, Vol. 58, No. 1, February 1976, pp. 31-38.
- Allen, J.E., and K.E. Gadson. "Nutrient Consumption Patterns of Low-Income Households." United States Department of Agriculture, Economic Research Service, Technical Bulletin No. 1685, June 1983.
- Basiotis, Panayotis P. "Food Costs, Nutrient Availability, and Nutrient Intake of Food Stamp Program Eligible Households: Analysis in a Household Production Framework." Ph.D. dissertation, University of Missouri, 1983.
- Basiotis, Peter, Mark Brown, S.R. Johnson, and Karen J. Morgan. "Nutrient Availability, Food Costs, and Food Stamps." American Journal of Agricultural Economics, Vol. 65, 1983, pp. 685-693.
- Benus, J., J. Kmenta, and H. Shapiro. "The Dynamics of Household Budget Allocation to Food Expenditures." The Review of Economics and Statistics, Vol. 58, No. 2, 1976, pp. 129-138.
- Blanciforti, Laura. "Food Stamp Program Effects in Puerto Rico." Economics Research Service staff report, U.S. Department of Agriculture, 1983.
- Brown, Mark, S.R. Johnson, and Robert L. Rizek. "Food Stamps and Expenditure Patterns: A Statistical Analysis." University of Missouri-Columbia. Report prepared under U.S. Department of Agriculture Grant No. 53-3244-9-188, 1982.
- Chen, Jain-Shing A. "Simultaneous Equations Models With Qualitative Dependent Variables: A Food Stamp Program Participation and Food Cost Analysis." Ph.D. dissertation, University of Missouri, 1983.
- Consumer and Food Economics Institute. "Composition of Foods: Dairy and Egg Products: Raw, Processed, Prepared." U.S. Department of Agriculture, Agriculture Handbook 8-1, 1976.
- Consumer and Food Economics Institute. "Composition of Foods: Spices and Herbs; Raw, Processed, Prepared." U.S. Department of Agriculture, Agriculture Handbook 8-2, 1977.
- Consumer and Food Economics Institute. "Composition of Foods: Baby Foods; Raw, Processed, Prepared." U.S. Department of Agriculture, Agriculture Handbook 8-3, 1978.

- Davis, Carlton G. "Linkages Between Socioeconomic Characteristics, Food Expenditure Patterns, and Nutritional Status of Low Income Households: A Critical Review." American Journal of Agricultural Economics, Vol. 64, 1982, pp. 1017-1025.
- Davis, C.G., and P.H. Neenan. "Impact of Food Stamp and Nutrition Education Programs on Food Group Expenditure and Nutrient Intake of Low-Income Households." Southern Journal of Agricultural Economics, Vol. 11, 1979, pp. 121-129.
- Food and Nutrition Board. Recommended Dietary Allowances, 9th Edition, Washington, D.C.: National Research Council, National Academy of Sciences, 1980.
- Heckman, James, J. "Sample Selection Bias as a Specification Error." Econometrica, Vol. 47, 1979, pp. 153-161.
- Hymans, Saul H., and Harold T. Shapiro. "The Allocation of Household Income to Food Consumption." Journal of Econometrics, Vol. 4, No. 2, 1976.
- Johnson, S.R., J.A. Burt, and K.J. Morgan. "The Food Stamp Program: Participation, Food Cost, and Diet Quality for Low-Income Households." Food Technology, 1981, pp. 58-70.
- Kennedy, Eileen T. "Dietary Assessment." Manual of Clinical Nutrition, David Paige (ed.). Nutrition Publications Inc., Pleasantville, New Jersey, 1983.
- Kennedy, E.T., M.W. Harrell, and B. Frazao. "Distribution of Nutrient Intake Across Meals in the United States Population." Ecology of Food and Nutrition, 1982, Vol. 11, pp. 217-224.
- Lane, Sylvia. "Food Distribution and Food Stamp Program Effects on Food Consumption and Nutritional 'Achievement' of Low-Income Persons in Kern County, California." American Journal of Agricultural Economics, Vol. 60, 1978, pp. 108-116.
- Madden, J. Patrick, and M. Yoder. "Program Evaluation: Food Stamp and Commodity Distribution on the Rural Areas of Central Pennsylvania." Bulletin 780, Agricultural Experiment Station, the Pennsylvania State University, University Park, PA, 1972.
- Moussie, M., C.G. Davis, L.B. Bailey, P.A. Wagner, H. Appledorft, J.S. Dinning, and G.J. Christakis. "Impact of Socioeconomic Characteristics on Food Expenditure Pattern and Adolescent Nutritional Status Among Low-Income Florida Households." Bulletin 837, Agricultural Experiment Stations, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL, 1983.

- Neenan, P.H. and G. Davis. "Impact of the Food Stamp Program on Low Income Household Food Consumption in Rural Florida." Southern Journal of Agricultural Economics, Vol. 9, 1977, pp. 89-97.
- Neenan, P.H., and C.G. Davis. "Impact of Food Stamps and Expanded Food and Nutrition Education Programs on Food Expenditure and Nutrient Intake of Low Income Rural Florida Households." Bulletin 805, Agricultural Experimental Stations, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL, 1978.
- Orr, M.L. "Pantothenic Acid, Vitamin B₆ and Vitamin B₁₂ in Foods." U.S. Department of Agriculture, Home Economic Research Report No. 36, 1969.
- Salathe, Larry E. "The Food Stamp Program and Low-Income Households' Food Purchases." Agricultural Economics Research, Vol. 32, No. 4, 1980.
- Scearce, W. Keith, and Robert B. Jensen. "Food Stamp Program Effects on Availability of Food Nutrients for Low-Income Families in the Southern Region of the United States." Southern Journal of Agricultural Economics, Vol. 11, No. 2, December 1979, pp. 113-120.
- Smallwood, David M., and James R. Blaylock. "Analysis of Food Stamp Program Participation and Food Expenditures." Economics Research Service staff report, U.S. Department of Agriculture, 1983.
- Stewart, J. "Notes on the Underground Economy," Puerto Rico Business Review. April 1984, pp. 19-30.
- U.S. Congress. The Congressional Record. Washington, D.C.: U.S. Government Printing Office, 1983.
- U.S. Department of Agriculture, Food and Nutrition Service, Evaluation of the Puerto Rico Nutrition Assistance Program. Washington, D.C., 1983.
- U.S. Department of Agriculture, Human Nutrition Information Service, Nationwide Food Consumption Survey 1977-78, Preliminary Report No. 9. Food Consumption and Dietary Levels of Households in Puerto Rico, Summer and Fall 1977. Washington, D.C., 1982a.
- U.S. Department of Agriculture, Human Nutrition Information Service, Nationwide Food Consumption Survey 1977-78, Preliminary Report No. 12. Food and Nutrient Intakes of Individuals in 1 Day in Puerto Rico, Summer and Fall 1977. Washington, D.C. 1982b.
- Watt, B., and A. Merrill. "Composition of Foods . . . Raw, Processed, Prepared." U.S. Department of Agriculture, Agricultural Handbook 8 (revised), 1963.
- Weimer, Jon P. "The Nutritional Status of the Elderly." National Food Review, Summer 1982, pp. 7-10.

West, Donald A. and David W. Price. "The Effects of Income, Assets, Food Programs, and Household Size on Food Consumption." American Journal of Agricultural Economics, Vol. 58, November 1976, pp. 725-730.

West, Donald A. "Effects of the Food Stamp Program on Food Expenditures." Office of Economic Analysis and Program Evaluation staff report, U.S. Department of Agriculture, 1979.

West, Donald A., David W. Price, and Dorothy Z. Price. "Impacts of the Food Stamp Program on Value of Food Consumed and Nutrient Intake Among Washington Households with 8-12 Year Old Children." Western Journal of Agricultural Economics, Vol. 3, No. 2, December 1978, pp. 131-144.

Whitfield, R.A. "A Nutritional Analysis of the Food Stamp Program." American Journal of Public Health, Vol. 72, No. 8, 1982, pp. 793-799.

APPENDIX A

RESULTS OF THE TIME-SERIES ANALYSIS OF FOOD EXPENDITURES

The analysis of consumption behavior presented in the body of this report was based on cross-section data collected at two points in time-- 1977 and 1984. While these time periods provide information on consumption behavior both prior to and following the introduction of the Nutrition Assistance Program (NAP) in Puerto Rico in 1982, the pre-NAP observation period is for a substantially different Food Stamp Program (FSP) than that which existed immediately prior to NAP. The primary change in the FSP between the 1977 survey and NAP was the elimination of the purchase requirement (EPR) in 1979. Given that both EPR and the switch to cash issuance occurred in the interval between the two surveys, it is difficult on the basis of the survey data to separate the impacts of these two major program changes on consumption behavior. In order to provide some additional insight into the separate impacts of EPR and NAP on food consumption behavior, a second analysis has been undertaken using time-series data. This appendix summarizes the findings from that analysis.

Before presenting the results from the analysis, it is important to note several limitations of the time-series work. First, unlike the cross-section work, the time-series results are based on aggregate data on consumption behavior. This is a drawback since relationships which exist at the individual level may be obscured when behavior is aggregated across all individuals. In addition, the time-series data are for the entire population of Puerto Rico rather than only the food assistance program eligible population. Thus, the time-series analysis provides estimates of the impact of program changes on the consumption behavior of the entire population while the cross-section work provides estimates of the impact on those directly affected by the changes--the population of program participants.

The final limitations of the time-series analysis arise because of the lack of monthly or quarterly data on consumption behavior. With only annual data available, there was only one post-NAP observation (FY 1983), which made it impossible to estimate the impact of NAP on consumption behavior.¹ As a result, the time-series analysis was restricted to the period FY 1948 to FY 1982 and focused on the differential impacts of the pre- and post-EPR Food Stamp Program on consumption behavior. The FSP was implemented in Puerto Rico in FY 1975 and the purchase requirement was eliminated in December 1978; hence, the estimation of these impacts was based on four pre-EPR FSP observations and four post-EPR FSP observations. The use of annual data creates a second difficulty since estimates of the marginal propensity to consume based on annual data are less precise than those using monthly or quarterly data. To the extent that the introduction of the FSP and the subsequent program changes produced multiple-round impacts on the consumption behavior of the Puerto Rico population, the estimates obtained in the time-series are likely to overstate the impact of the program on the consumption behavior of the program eligible population.

In examining the impact on consumption behavior of the Food Stamp Program both prior to and following EPR, aggregate demand equations for per-capita food and nonfood consumption expenditures were estimated.² From

¹The food assistance program data were provided by the U.S. Department of Agriculture. The remaining data were drawn from Puerto Rico's National Income accounts and related data.

²The demand equations were estimated both separately and as a system of equations (linear expenditure system). Since the estimated impacts of the changes in the food assistance program on consumption behavior were equivalent under both approaches, the findings from the simpler, single equation estimation are presented in this appendix.

these equations, estimates were obtained of the marginal propensity to consume food and nonfood items from the pre-EPR food stamp benefit, the post-EPR food stamp benefit, and income.¹ Table A.1 summarizes the estimates of the marginal propensities to consume, while Table A.2 presents the ordinary least squares estimates upon which the MPCs are based.² Table A.3 contains the means and standard deviations for the dependent and explanatory variables.

As can be seen from Table A.1, the estimated marginal propensity to consume food out of food stamp benefits was quite high both prior to and following EPR. Under the pre-EPR FSP approximately \$.51 of every additional dollar of food stamp benefit was spent on food products, while following EPR the MPC from food stamp benefits fell to about .28. These estimates of the MPC from food stamp benefits are substantially greater

¹Income was defined as per-capita total expenditures on food and nonfood items minus the value of the food stamp benefit. The definition of "income" as total expenditures is consistent with the majority of demand analyses which seek to abstract from the issue of savings. However, in Puerto Rico the issue is somewhat different since, according to published statistics, total consumption expenditure has exceeded disposable personal income for 29 of the last 36 years. Although the exact source of the funds for the additional expenditures is not known, the most reasonable explanation attributes the greater expenditures to substantial underreporting of

both consumption and income within the Puerto Rico economy, with income more easily misreported. Unfortunately, although the size of the underground economy is projected to be quite large, there are no data available to determine accurately the size of the underground economy in Puerto Rico nor to test the reliability of alternative explanations of the higher level of consumption.

²In addition to these simple models, several alternative specifications of the equations were estimated. The results were very stable with respect to specifications which included additional explanatory variables (e.g., unemployment rate, time trend, lagged endogenous variables). The food consumption equation results were also stable with respect to alterna-

than the results obtained for either food stamp benefits or NAP benefits in the cross-section work. The estimates obtained for the marginal propensity to consume food from income are approximately equal in the time-series and cross-section analyses. Thus, the time-series provides support for the cross-section estimate of the MPC from income of approximately .14.

Efforts to reconcile the differences in the MPC estimates from the cross-section and time-series work have not been successful. Given the limited number of observations available in the time-series work, the possibility of multiple-round impacts, the aggregate level data, and possible underreporting of personal consumption in the National Income accounts statistics (projected to be quite large),¹ the time-series results are probably less reliable than those of the cross-section analyses.

¹Stewart (1984) projects that the scale of the underground economy in Puerto Rico far exceeds the 10 to 15 percent of GNP which has been estimated for the United States.

TABLE A.1

ESTIMATES OF THE MARGINAL PROPENSITIES TO CONSUME
FOOD AND NONFOOD PRODUCTS FROM INCOME AND FOOD STAMP
PROGRAM BENEFITS IN PUERTO RICO, FY 1948-FY 1982

	Food	Nonfood	Total
MPC _{Pre-EPR FSP Benefit}	.506**	.496**	1.002
MPC _{Post-EPR FSP Benefit}	.279**	.747**	1.026
MPC _{Income}	.139**	.865**	1.004
\bar{R}^2	.9866	.9996	

*Significant at the .05 level, two-tailed test.

**Significant at the .01 level, two-tailed test.

TABLE A.2

OLS ESTIMATION RESULTS FOR PER-CAPITA PERSONAL
CONSUMPTION EXPENDITURE ON FOOD AND NONFOOD
PRODUCTS IN PUERTO RICO, FY 1948-FY 1982

(standard errors in parentheses)

Explanatory Variable	Food Products	Nonfood Products
Constant	619.6468 (44.138)**	894.3734 (218.770)**
Total personal consumption expenditures minus food stamp benefits	0.1391 (0.005)**	0.8653 (0.005)**
Food stamp benefits	0.5062 (0.047)**	0.4964 (0.055)**
Interaction of a post-EPR dummy variable and food stamp benefits	-0.2276 (0.043)**	0.2502 (0.050)**
Ratio of implicit price deflator for food products to implicit price deflator for all personal consumption	-429.5667 (61.485)**	--
Ratio of implicit price deflator for nonfood products to implicit price deflator for all personal consumption	--	-1108.7538 (200.110)*
\bar{R}^2	.9866	.9996
DW statistic	2.0798	2.0796
N	35	35

NOTE: Dollar denominated variables are on a per-capita basis and are in constant (1984) dollars.

*Significant at the .05 level, two-tailed test.

**Significant at the .01 level, two-tailed test.

TABLE A.3
MEANS AND STANDARD DEVIATIONS FOR DEPENDENT AND
EXPLANATORY VARIABLES, FY 1948-FY 1982

Variable	Mean	Standard Deviation
Personal consumption expenditures on food products	\$617.70	\$140.84
Personal consumption expenditures on nonfood products	\$1,955.20	\$990.18
Total personal consumption expenditures minus food stamp benefits	\$2,512.66	\$1,048.51
Food stamp benefits	\$60.23	\$115.89
Interaction of post-EPR dummy variable and food stamp benefits	\$31.96	\$91.38
Ratio of implicit price deflator for food products to implicit price deflator for all personal consumption	0.87	0.11
Ratio of implicit price deflator for nonfood products to implicit price deflator for all personal consumption	1.04	0.04

SOURCE: Junta de Planificacion, Ingreso y Producto; U.S. Department of Agriculture.

NOTE: Dollar denominated variables are on a per-capita basis and are in constant (1984) dollars.

APPENDIX B

TABULAR ESTIMATES OF THE IMPACT OF NAP ON
FOOD EXPENDITURES AND NUTRIENT AVAILABILITY

The comparison of average weekly food expenditures for different population subgroups between 1977 and 1984 can provide rough estimates of the impact of NAP on food expenditures. Similarly, the comparison of average nutrient availability can provide rough estimates of the impact of NAP on nutrient availability. These estimates are only rough approximations since they do not fully isolate the effects of NAP from the effects of changes in factors unrelated to NAP that also influence food use (e.g., prices, family size, income) and since they do not permit the partitioning of the effects of NAP into the effects due to cash issuance and those due to tighter benefit and eligibility restrictions. Given these limitations, these estimates are viewed as of secondary importance and as such are presented as an appendix to the main report.

In this appendix, the tabular analysis of the impact of NAP on food expenditures is considered first, followed by the analysis of the impact on nutrient availability.

A. FOOD EXPENDITURES

The estimates of the impact of NAP on food expenditures are computed as the difference in the average value of food expenditures between NAP participants in 1984 and FSP participants in 1977 compared to the difference in the average value of food expenditures for program-eligible nonparticipants between 1984 and 1977. More concisely, let F denote average food expenditures, P denote participants, and NP program-eligible nonparticipants; then the estimate of the effect of NAP on food expenditures is the following:

$$(F_{P,1984} - F_{P,1977}) - (F_{NP,1984} - F_{NP,1977}).$$

The first term, the difference in food expenditures for program participants, provides a measure of the impact of NAP which makes no adjustment for changes in factors other than NAP which influenced food use. By including the second term, the difference in food expenditures for program-eligible nonparticipants, a rough adjustment is made for changes in factors not related to NAP which affected food use. That is, to the extent that the change in average food expenditures of the program-eligible nonparticipant group reflects the effects of changes in background factors that also applied to the program participants, the difference between the participant and program-eligible nonparticipant differences in average food expenditures measures the impact of NAP on food expenditures adjusted for background factors.

The program participant and program-eligible nonparticipant comparison groups to be used in calculating these tabular estimates (difference of differences) of the impact of NAP are somewhat difficult to define since the compositions of the groups are not strictly independent of the changes introduced by NAP. In particular, since NAP has more stringent income-eligibility limits than the former FSP, some previously eligible and participating households were made ineligible under NAP. Thus, a 1984 nonparticipant comparison group based on eligibility for the FSP will presumably include some households who would have been FSP participants in 1977. This problem can be avoided by restricting the nonparticipant comparison group to those households in 1977 and 1984 who would be eligible under NAP regulations (adjusted for inflation). The estimates based on this comparison group provide measures of the impact of cash issuance and

benefit reduction, while controlling for the effects of NAP's stricter eligibility requirements.

One potential problem with the use of the program participant/NAP-eligible nonparticipant comparison group is that there will not be a set of nonparticipants in either year which correspond to the 1977 FSP participants who would not be eligible for NAP. The use of the NAP-eligible participants/ NAP-eligible nonparticipants comparison group avoids this problem by restricting the set of participants and nonparticipants to those eligible for NAP. However, this ignores the restriction on eligibility component of the NAP changes.

In order to compensate for the fact that each participant/comparison group has drawbacks, several different comparison groups are used. The tabular estimates of the impact of NAP on total food expenditures and the money value of food used at home are presented in Table B.1 for the different participant/program-eligible nonparticipant comparison groups. The food expenditures values upon which these estimates are based are contained in Table B.2.

The tabular estimates of the impact of NAP, as seen in Table B.1, vary considerably across the comparison groups used and by whether the estimates are in constant or nominal dollars. Focusing only on the constant dollar estimates, it can be seen that the decline in real food expenditures for program participants between 1977 and 1984 was 7.7 percent for total food expenditures and 6.7 percent for the money value of food used at home. When program-eligible nonparticipant comparison groups are used to provide adjustments for changes in other (non-NAP) background factors, the estimates of the impact of NAP are considerably below the 7 to

TABLE B.1

CHANGES IN FOOD EXPENDITURES IN PUERTO RICO
BETWEEN 1977 AND 1984

Participant/ Program-eligible Nonparticipant Comparison Group	Total Food Expenditures per Adult Male Equivalent (\$/week) ^a		Money Value of Food Used at Home per Equivalent Nutrition Unit (\$/week) ^b	
	Change as a Percent		Change as a Percent	
	Dollar Amount of Change	of the 1977 Mean Value for Participants	Dollar Amount of Change	of the 1977 Mean Value for Participants
Participants Only				
Nominal Dollars	5.72	25.5	5.92	27.0
Constant (1984) Dollars	-2.34	-7.7	-2.00	-6.7
Participants/ FSP-Eligible Nonparticipants				
Nominal Dollars	-1.94	-8.7	-1.70	-7.8
Constant (1984) Dollars	-1.11	-3.6	-0.97	-3.3
Participants/ NAP-Eligible Nonparticipants				
Nominal Dollars	-0.88	-3.9	-0.60	-2.7
Constant (1984) Dollars	-0.48	-1.6	-0.20	-0.7
NAP-Eligible Participants/ NAP-Eligible Nonparticipants				
Nominal Dollars	-0.61	-2.8	-0.44	-2.0
Constant (1984) Dollars	-0.15	-0.5	0.02	0.1

SOURCE: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

NOTES: The changes in food expenditures are calculated as follows. Let F denote average food expenditures, P denote participants, and NP program-eligible nonparticipants, then the estimate of the effect of NAP on food expenditures is:

$$\Delta F = (F_{P,1984} - F_{P,1977}) - (F_{NP,1984} - F_{NP,1977}).$$

Table B.2 contains the relevant values of F .

^aEquals the sum of the money value of food used at home, amount spent on meals and snacks away from home, and the value of school lunches and breakfasts divided by household size in adult male equivalents.

^bAn equivalent nutrition unit is a 21-meal-at-home-adult-male-equivalent person, based upon 1980 RDA for food energy.

TABLE B.2

MEAN VALUES OF FOOD EXPENDITURES IN PUERTO RICO
BY ELIGIBILITY AND PARTICIPATION STATUS, 1977 AND 1984

Eligibility and Participation Status	Sample Size	Total Food Expenditure Per Adult Male Equivalent (\$/week) ^a		Money Value of Food Used at Home. Per Equivalent Nutrition Unit (\$/week) ^b	
		Nominal Dollars	Constant (1984) Dollars	Nominal Dollars	Constant (1984) Dollars
1. FSP Participants, 1977	1,381	22.40	30.49	21.94	29.86
a. NAP-Eligible	1,231	22.16	30.16	21.78	29.64
2. FSP-Eligible FSP Nonparticipants, 1977	882	24.62	33.51	23.97	32.62
a. NAP-Eligible	460	23.43	31.89	23.06	31.38
3. NAP Participants, 1984	883	28.15	28.15	27.86	27.86
4. FSP-Eligible NAP Nonparticipants, 1984	849	32.28	32.28	31.59	31.59
a. NAP-Eligible	420	30.03	30.03	29.58	29.58

SOURCE: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

^aEquals the sum of the money value of food used at home, amount spent on meals and snacks away from home, and the value of school lunches and breakfasts divided by household size in adult male equivalents.

^bAn equivalent nutrition unit is a 21-meal-at-home-adult-male-equivalent person, based upon 1980 RDA for food energy.

8 percent total change. Although these adjusted estimates are quite sensitive to the comparison groups chosen, the range of results are consistent with the findings of the multivariate work reported in Chapter III. The tabular estimates of the impacts of NAP on total food expenditures range from a decline of less than 1 percent to a decline of about 4 percent, while the estimated impact on the money value of food used at home ranges from close to 0 to a decrease of about 3 percent.

B. NUTRIENT AVAILABILITY

Rough estimates of the impact of NAP on nutrient availability are obtained using the difference of differences approach outlined in the previous section for food expenditures. The change in nutrient availability between 1984 and 1977 for program-eligible nonparticipants is subtracted from the change for participants to provide an estimate of the impact of NAP that controls for changes in other (non-NAP) background factors. For example, if there had been Islandwide changes in food consumption and nutrient availability which affected participants and program-eligible nonparticipants equally, the difference of differences approach would account for this change.

Two measures of diet quality are used in this analysis--the nutritive value of food used at home per equivalent nutrition unit and the percentage of households meeting the 1980 RDA. Food energy and five key nutrients are examined: calcium, vitamin A, iron, vitamin B₆, and magnesium. As discussed in Chapter IV, these nutrients were chosen because of evidence of potentially low levels in the diets of Puerto Rico households.

The estimates of the impact of NAP on the average nutritive value of food used at home per equivalent nutrition unit are presented in Table B.3. Table B.4 presents similar estimates for the percentage of households meeting the RDA. The nutrient availability data upon which these estimates are based are contained in Table B.5 for the average nutritive value of food used at home (Table B.3) and Table B.6 for the percentage of households meeting the RDA (Table B.4).

The evidence from the changes in both the average nutritive value of food used at home (Table B.3) and the percentage of households meeting the RDA (Table B.4) suggest that the total change in the quality of diets between 1977 and 1984 was very minimal.¹ Of the five nutrients and food energy, only iron and vitamin B₆ showed total changes of greater than 5 percent over the 1977 to 1984 period. When nonparticipant comparison groups are used to adjust for changes in background factors other than NAP, the estimated impacts of NAP on diet quality vary widely by comparison group and by the measure of diet quality. The estimates of the impact of NAP based on the percentage of households meeting the RDA are, for the most part positive, while the estimates based on the average nutritive value of food used at home are generally negative. However, as these are two very different measures of diet quality and the estimated impacts under both measures suggest small changes for almost all nutrients, the results are not necessarily inconsistent. The nutrients for which there does appear to have been a substantial NAP-induced effect are vitamin A, iron, and vitamin

¹The total change is indicated by the changes for participants only (i.e., changes unadjusted for changes in other background factors).

TABLE B.3

CHANGES IN AVERAGE NUTRITIVE VALUE OF FOOD USED AT HOME PER
NUTRITION UNIT PER DAY IN PUERTO RICO BETWEEN 1977 AND 1984

Participant/ Program-Eligible Nonparticipant Comparison Group	Nutrient											
	Food Energy (Kcal)		Calcium (mg)		Vitamin A (IU)		Iron (mg)		Vitamin B ₆ (mg)		Magnesium (mg)	
	Total Change	Change as a Percent of 1977 Mean Value for Participants	Total Change	Change as a Percent of 1977 Mean Value for Participants	Total Change	Change as a Percent of 1977 Mean Value for Participants	Total Change	Change as a Percent of 1977 Mean Value for Participants	Total Change	Change as a Percent of 1977 Mean Value for Participants	Total Change	Change as a Percent of 1977 Mean Value for Participants
Participants Only	41.32	0.9	-23.44	-2.1	3.61	0.1	1.13	6.2	0.09	3.3	11.03	2.0
Participants/ FSP-Eligible Nonparticipants	-169.19	-3.7	-14.30	-1.3	438.96	9.6	-0.45	-2.5	-0.10	-3.7	-18.98	-3.4
Participants/ NAP-Eligible Nonparticipants	-151.82	-3.4	-6.68	-0.6	818.87	11.8	-0.66	-3.6	-0.06	-2.2	-24.28	-4.4
NAP-Eligible Participants/ NAP-Eligible Nonparticipants	-163.14	-3.6	0.85	0.1	880.97	12.8	-0.84	-4.6	-0.04	-1.5	-24.98	-4.5

SOURCE: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

NOTE: A nutrition unit is a 21-year-old male equivalent person, based on 1980 RDA for each nutrient. The changes in nutrient availability are calculated as follows. Let F denote average nutrient availability, P denote participants, and NP program-eligible nonparticipants, then the estimate of the effect of NMP on nutrient availability is:

$$\Delta F = (F_{P,1984} - F_{P,1977}) - (F_{NP,1984} - F_{NP,1977})$$

Table B.5 contains the relevant values of F.

TABLE B.4

CHANGES IN PERCENTAGE OF HOUSEHOLDS MEETING RECOMMENDED
DIETARY ALLOWANCES IN PUERTO RICO BETWEEN 1977 AND 1984

Participant/ Program-Eligible Nonparticipant Comparison Group	Nutrient					
	Food Energy	Calcium	Vitamin A	Iron	Vitamin B ₆	Magnesium
Participants Only	1.6	-0.4	1.9	4.9	6.0	1.8
Participants/ FSP-Eligible Nonparticipants	0	1.0	2.4	2.9	1.7	2.0
Participants/ NAP-Eligible Nonparticipants	0.5	2.4	3.9	2.9	3.1	2.3
NAP-Eligible Participants/ NAP-Eligible Nonparticipants	1.0	3.6	4.3	3.0	3.8	2.5

SOURCE: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

NOTE: The changes in nutrient availability are calculated as follows. Let F denote average nutrient availability, P denote participants, and NP program-eligible nonparticipants, then the estimate of the effect of NAP on nutrient availability is:

$$\Delta F = (F_{P,1984} - F_{P,1977}) - (F_{NP,1984} - F_{NP,1977}).$$

Table B.6 contains the relevant values of F.

TABLE B.5

AVERAGE NUTRITIVE VALUE OF FOOD USED AT HOME PER NUTRITION UNIT PER DAY
IN PUERTO RICO BY ELIGIBILITY AND PARTICIPATION STATUS, 1977 AND 1984

Eligibility and Participation Status	Sample Size	Nutrient					
		Food Energy (Kcal)	Calcium (mg)	Vitamin A (IU)	Iron (mg)	Vitamin B ₆ (mg)	Magnesium (mg)
1. FSP Participants, 1977	1,381	4,469.30	1,102.32	6,970.52	18.13	2.74	553.30
a. MAP-Eligible	1,231	4,479.98	1,094.79	6,908.82	18.31	2.72	554.20
2. FSP-Eligible FSP Nonparticipants, 1977	882	4,391.59	1,195.07	7,832.15	18.17	2.78	553.78
a. MAP-Eligible	460	4,347.52	1,165.13	7,602.82	17.98	2.69	544.42
3. MAP Participants, 1984	883	4,510.62	1,078.88	6,974.13	19.26	2.83	564.53
4. FSP-Eligible MAP Nonparticipants, 1984	849	4,598.06	1,185.93	7,396.80	19.75	2.97	583.39
a. MAP-Eligible	420	4,540.66	1,148.37	6,787.56	19.77	2.84	579.73

SOURCE: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

NOTE: A nutrition unit is a 21-meal-at-home-adult-male-equivalent person, based upon the 1980 RDA for each nutrient.

TABLE B.6
PERCENTAGE OF HOUSEHOLDS MEETING RECOMMENDED DIETARY ALLOWANCES
IN PUERTO RICO BY ELIGIBILITY AND PARTICIPATION STATUS, 1977 AND 1984
(percent)

Eligibility and Participation Status	Sample Size	Nutrient					
		Food Energy	Calcium	Vitamin A	Iron	Vitamin B ₆	Magnesium
1. FSP Participants, 1977	1,381	85.0	69.2	52.5	83.4	63.2	82.8
a. NAP-Eligible	1,231	84.5	68.0	52.1	83.3	62.5	82.6
2. FSP-Eligible FSP Nonparticipants, 1977	882	85.2	74.9	62.8	84.4	65.4	83.5
a. NAP-Eligible	460	83.1	71.3	57.2	83.3	62.7	82.6
3. NAP Participants, 1984	883	86.6	68.8	54.4	88.3	69.2	84.6
4. FSP-Eligible NAP Nonparticipants, 1984	849	86.8	73.5	62.3	86.4	69.7	83.3
a. NAP-Eligible	420	84.2	68.5	55.2	85.3	65.6	82.1

SOURCE: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

B₆. It should be noted that the apparent large effect for vitamin A appears to be the result of a statistical artifact.¹

¹The distribution of vitamin A availability is characterized by a large number of households whose per-person availability of vitamin A is around 5,000 I.U. (the RDA for vitamin A). At the same time, a substantial number of households have very large amounts of vitamin A due to the high use of foods rich in vitamin A (vegetables, dairy products, and fruits). This finding, common in food use surveys, is typical for vitamin A, but less so for the other key nutrients. A method to reduce the impact of such very large values is to take a logarithmic transformation of vitamin A availability, which was done in the statistical analysis of nutrient availability.

APPENDIX C

TECHNICAL APPENDIX FOR THE ANALYSIS OF FOOD EXPENDITURES AND NUTRIENT AVAILABILITY

This appendix describes the technical details of the statistical and simulation analyses of food expenditures and nutrient availability, as summarized in a non-technical manner in Chapters III and IV of the report. The overall approach of the analysis is based on a block recursive model of food expenditures and nutrient availability. That is, food assistance benefits (either cash or coupons) are presumed to increase food expenditures, which in turn are believed to increase the availability of nutrients to recipient households. Thus, the impact of NAP or FSP benefits on nutrient availability are obtained indirectly from the effect of food assistance benefits on food expenditures and the effect of food expenditures on nutrient availability.

Sections A and B of the appendix present the econometric model of food expenditures and nutrient availability, respectively. Section C describes the simulation analyses used to generate the predicted effects of cash issuance and the restrictions on eligibility and benefits on food expenditures and nutrient availability.

A. ECONOMETRIC ANALYSIS OF FOOD EXPENDITURES

Full Information Maximum Likelihood (FIML) is used to estimate a model of food expenditures (total food expenditures and the money value of food used at home) and participation in the Food Stamp Program or Nutrition Assistance Program. FIML corrects for possible biases in estimates of the food expenditure equation that could arise from the self-selection of participant households from the population of eligible households.

1. Model of Food Expenditures and Program Participation

The basic model of food expenditures and program participation estimated for the report is the following:

$$F_i = X_i \beta + \alpha B_i + \epsilon_i \quad (1)$$

$$P_i^* = Z_i \delta + u_i \quad (2)$$

$$P_i = 1 \text{ if } P_i^* = Z_i \delta + u_i \geq 0 \quad (3)$$

$$= 0 \text{ if } P_i^* = Z_i \delta + u_i < 0,$$

where F_i is food expenditures of the i th household (appropriately scaled), X_i is a vector of household characteristics affecting food expenditures, B_i is the food assistance benefit, P_i^* is an unobserved latent variable underlying the program participation decision, Z_i is a vector of household characteristics (which may or may not contain elements of X) which influence the FSP or NAP participation decision of program eligibles, P_i is a dichotomous variable denoting participation (1 = participant, 0 = nonparticipant), and ϵ_i and u_i are random disturbance terms. Assumptions regarding the random disturbance terms are the following:

$$\epsilon_i \sim N(0, \sigma^2)$$

$$u_i \sim N(0, 1)$$

$$\text{Cov}(\epsilon_i, u_i) = \begin{matrix} \sigma^2 & \sigma_{\epsilon u} \\ \sigma_{\epsilon u} & 1 \end{matrix}$$

The primary objective of the analysis of food expenditures is to obtain consistent estimates of α , the marginal effect of food assistance benefits on food expenditures. Most previous analyses of food expenditures obtained an estimate of α simply by estimating equation (1) without reference to the program participation decision denoted by equations (2) and (3) (a notable exception to this is the study by Chen, 1983). A potential problem with the estimates of α based on these studies is that FSP or NAP participants may have higher food expenditures than otherwise similar eligible nonparticipants even in the absence of a food assistance program, and the failure to recognize the interdependence of the food expenditure and program participation equations may result in biased estimates of α . This potential bias is called sample selection bias, as FSP or NAP participants are potentially a self-selected group of households with higher than average values of food expenditures.

Likelihood Function. Three possible participation categories exist for the sample of households used to estimate the model of food expenditures and program participation:

$$1. \text{ Participants: } F_i = X_i \beta + \alpha B_i + \epsilon_i$$

$$P_i^* = Z_i \delta + u_i \geq 0$$

$$2. \text{ Eligible nonparticipants: } F_j = X_j \beta + \epsilon_j$$

$$P_j^* = Z_j \delta + u_j < 0$$

$$3. \text{ Ineligibles: }^1 F_k = X_k \beta + \epsilon_k$$

(no P^* equation)

The log likelihood function for this model is the sum of the log probabilities of observing: (1) the food expenditures and participation status of participants, (2) the food expenditures and participation status of eligible nonparticipants, and (3) the food expenditures of ineligible households. The log-likelihood function is

$$L = \sum_i \log(\text{Prob1}_i) + \sum_j \log(\text{Prob2}_j) + \sum_k \log(\text{Prob3}_k),$$

where i, j , and k are indexes ranging over participants, eligible nonparticipants, and ineligibles, respectively. The three probabilities are defined as follows:

$$\begin{aligned} \text{Prob1}_i &= \text{Prob}(F_i = X_i \beta + \alpha B_i + \epsilon_i, Z_i \delta + u_i \geq 0) \\ &= \text{Prob}(\epsilon_i = F_i - X_i \beta - \alpha B_i, u_i \geq -Z_i \delta) \\ &= D(z_{1i}) * [(1 - C(w_{1i}))] / \sigma \end{aligned}$$

$$\begin{aligned} \text{Prob2}_j &= \text{Prob}(F_j = X_j \beta + \epsilon_j, Z_j \delta + u_j < 0) \\ &= \text{Prob}(\epsilon_j = F_j - X_j \beta, u_j < -Z_j \delta) \\ &= D(z_{2j}) * C(w_{2j}) / \sigma \end{aligned}$$

$$\begin{aligned} \text{Prob3}_k &= \text{Prob}(F_k = X_k \beta + \epsilon_k) \\ &= \text{Prob}(\epsilon_k = F_k - X_k \beta) \\ &= D(z_{2k}) / \sigma \end{aligned}$$

¹As discussed below, FSP-eligible households are used for the analysis in both 1977 and 1984. In 1984, however, some FSP-eligible

where $z_1 \equiv (F - X\beta - \alpha B)/\sigma$

$z_2 \equiv (F - X\beta)/\sigma$

$w_1 \equiv (-Z\delta - \rho z_1)/\sqrt{1 - \rho^2}$

$w_2 \equiv (-Z\delta - \rho z_2)/\sqrt{1 - \rho^2}$

$\rho \equiv \text{cov}(\varepsilon, u)/\sigma$

D is the standard normal probability density function

C is the cumulative standard normal distribution function.

The maximum likelihood estimates of α , β , δ , ρ , and σ , were obtained by an iterative program which searched over possible values of the parameters to maximize the log-likelihood function.

Detailed Model Specification. Several issues were resolved in the course of the analysis of food expenditures. The most important issues are the following:

- o Definition of the food expenditure variable
- o Determination of the sample on which to estimate the food expenditures model
- o Adjustment for different prices of food between 1977 and 1984
- o Scaling adjustments

The first issue considered is the appropriate measure of food expenditures. Two measures of food expenditures were used in the analysis--total food expenditures and the money value of food used at home. Total food expenditures were used as a dependent variable since this variable is the most comprehensive measure of food expenditures available from the data. It is defined as the sum of the money value of food used at home,

expenditures on meals and snacks away from home, and the subsidy value of school lunches and school breakfasts. The money value of food used at home is also an important dependent variable because the nutrient availability data are available only for food used at home and, hence, this variable links the food expenditure and nutrient availability analyses. The money value of food used at home is the sum of the money value of purchased food, home-produced food, and food received as a gift or pay.

The food expenditure model was estimated separately for 1977 and 1984, based on data from FSP-eligible households. FSP-eligible households in 1977 include FSP participants and eligible nonparticipants. In 1984, FSP-eligible households include NAP participants, NAP-eligible nonparticipants, and NAP-ineligible, FSP-eligible nonparticipants (category 3 of the likelihood function). FSP-eligible households were used in the analysis in order to analyze jointly the food expenditure and program participation decisions. Although some of these households were ineligible for NAP in 1984, they were used in the 1984 analysis in order to keep the analysis samples comparable in 1977 and 1984.¹ In addition, to the extent that NAP's restrictions on eligibility did not change the underlying food expenditure behavior of NAP-ineligible, FSP-eligible households (other than the effect of the elimination of food assistance benefits), these households should be kept in the analysis in order to increase the efficiency of the parameter estimators.

¹As discussed in Chapter III, these NAP-ineligible, FSP-eligible households are not used in the analysis of participation in NAP, but are used in the analysis of food expenditures.

The third major issue considered in the analysis of food expenditures was the inflation in the price of food between 1977 and 1984. All dollar-based variables (income, food assistance benefits, and all measures of food expenditures) were expressed in 1984 dollars. The 1977 nominal values were inflated by a price index for food, calculated from the 1977 and 1984 data bases. The price index was calculated from the average quantities and prices of the major food groups in 1977, and from the average prices of the major food groups in 1984, as follows:

$$\text{price index} = \frac{\sum_i p_{i,84} x_{i,77}}{\sum_i p_{i,77} x_{i,77}}$$

where i denotes food groups, p is average price, and x is the average quantity used. The price index is 1.361, indicating that, on average, the price of food was 36.1 percent higher in 1984 than in 1977.

The final major issue considered in the analysis of food expenditures was the adjustment for household size. Total food expenditures, income, program benefits, and guests meals were scaled by adult-male-equivalent persons, based on the 1980 RDA for food energy, and the money value of food used at home was scaled by equivalent nutrition units, which adjusts household size for both the number of adult male equivalents and the proportion of meals eaten at home. These adjustments were made because the age and sex composition of persons consuming food and the number of meals eaten at home are important predictors of food expenditures.

2. Empirical Results

The variables used in the analysis of food expenditures and program participation (and their mean values) are presented in Tables C.1 and C.2, respectively. Most of these variables are self-explanatory. An exception is the variable called household potential weekly food assistance benefit, presented in Table C.2 and used in the FSP and NAP participation analyses. This variable is the predicted food assistance benefit for eligible nonparticipants and the actual benefit for participants. The predicted benefit amount was obtained by a regression equation for food assistance benefits based on FSP participants in 1977 and NAP participants in 1984. Briefly, these equations estimated the relationship between benefits and household income and household size.

The results of the analysis of total food expenditures are presented in Table C.3. As discussed in the text and shown in Table C.3, the MPCs out of food assistance benefits are .213 for coupons and .226 for cash, indicating that the switch to cash issuance had virtually no impact on total food expenditures. The estimates of the MPC out of money income are .138 for 1977 and .164 for 1984 and are smaller than those out of food assistance benefits. Although the difference between the MPCs out of money income and out of food assistance benefits in each year is not significantly different from zero, the direction of the difference suggests there was a tendency in both years to spend somewhat more of an extra dollar of program benefits on food than an extra dollar of money income.

The results of the participation equation, which was estimated jointly with the total food expenditure equation, are presented in Table C.4. Most of the estimated coefficients have the expected signs, including

TABLE C.1

MEAN VALUES OF VARIABLES IN THE MONEY-VALUE-OF-FOOD-USED-AT-HOME AND TOTAL
FOOD EXPENDITURE EQUATIONS FOR FOOD-STAMP-ELIGIBLE HOUSEHOLDS IN PUERTO RICO

Variable	1977		1984	
	FSP Participants	FSP-Eligible Nonparticipants	MAP Participants	FSP-Eligible Nonparticipants ^a
Household Weekly Cost of Food-at-Home per Equivalent Nutrition Unit ^b	\$29.86	\$32.62	\$27.86	\$31.59
Household Weekly Total Food Cost per Adult Male Equivalent	\$30.50	\$33.52	\$28.16	\$32.29
Household Weekly Money Income per Adult Male Equivalent	\$24.86	\$47.97	\$24.02	\$52.80
Household Weekly Food Benefit per Adult Male Equivalent	\$12.04	\$0.00	\$11.38	\$0.00
Weekly Subsidy Value of School Breakfasts per Adult Male Equivalent	\$0.08	\$0.03	\$0.17	\$0.06
Weekly Subsidy Value of School Lunches per Adult Male Equivalent	\$0.94	\$0.53	\$1.12	\$0.67
Weekly Value of Home-Grown Food per Adult Male Equivalent	\$0.74	\$0.72	\$0.98	\$1.27
Weekly Value of Gift/Pay Food per Adult Male Equivalent	\$0.71	\$0.94	\$1.24	\$1.15
Female Head Present	0.96	0.94	0.97	0.96
Black	0.14	0.10	0.13	0.11
Number of Adult-Male-Equivalent Persons	3.79	3.18	3.52	3.01
Number of Guest Meals per Adult Male Equivalent	0.89	1.20	1.22	1.54
N	1,381	882	883	849

SOURCES: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

NOTE: Dollar amounts are in constant (1984) dollars. Weighted data were used.

^aMean values are based upon 1984 survey households that did not participate in MAP and that would have been eligible to participate in the 1977 FSP, after adjusting for inflation.

^bAn "equivalent nutrition unit" is a 21-meal-at-home-adult-male-equivalent person, based upon 1980 RDA for food energy.

TABLE C.2

MEAN VALUES OF VARIABLES IN THE FSP AND NAP PARTICIPATION EQUATIONS
FOR FSP- AND NAP-ELIGIBLE HOUSEHOLDS IN PUERTO RICO

	1977		1984	
	FSP Participants	FSP-Eligible Nonparticipants	NAP Participants	NAP-Eligible Nonparticipants
Household Weekly Money Income	\$81.69	\$137.34	\$73.08	\$101.24
Household Potential Weekly Food Assistance Benefit	\$42.40	\$32.33	\$37.16	\$28.41
Nonmetropolitan	0.66	0.53	0.69	0.63
Black	0.14	0.10	0.13	0.12
Male Head of Household Only	0.04	0.06	0.03	0.04
Female Head of Household Only	0.26	0.19	0.34	0.30
Own Home	0.71	0.79	0.68	0.84
Head of Household is 35 to 59 Years Old ^a	0.50	0.52	0.47	0.43
Head of Household is 60 Years Old or Over ^a	0.22	0.25	0.27	0.43
Head of Household Completed High School ^a	0.15	0.33	0.20	0.27
Male Head Employed	0.29	0.51	0.23	0.32
Female Head Employed	0.09	0.18	0.07	0.10
N	1,381	882	883	420

SOURCES: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

NOTE: Dollar amounts are in constant (1984) dollars. Weighted data were used.

^aThe household head is the female head if one is present, otherwise it is the male head.

TABLE C.3
ESTIMATES OF TOTAL FOOD EXPENDITURE EQUATIONS FOR
FOOD-STAMP-ELIGIBLE PUERTO RICO HOUSEHOLDS

(standard errors in parentheses)

Explanatory Variables	1977	1984 ^a
Constant	28.155** (1.394)	25.356** (1.572)
Household Weekly Money Income per Adult Male Equivalent	0.142** (0.013)	0.178** (0.012)
Household Weekly Food Benefit per Adult Male Equivalent	0.213** (0.051)	0.226** (0.047)
Weekly Subsidy Value of School Breakfasts per Adult Male Equivalent	0.195 (1.133)	0.543 (0.867)
Weekly Subsidy Value of School Lunches per Adult Male Equivalent	0.828** (0.245)	0.905** (0.250)
Weekly Value of Home Grown Food per Adult Male Equivalent	1.292** (0.120)	1.415** (0.101)
Weekly Value of Gift/Pay Food per Adult Male Equivalent	1.042** (0.090)	1.245** (0.100)
Female Head Present	3.826** (0.950)	1.323 (1.158)
Black	-2.040** (0.780)	-2.308** (0.882)
Number of Adult-Male-Equivalent Persons	-2.384 (0.185)	-2.164** (0.223)
Number of Guest Meals per Adult Male Equivalent	0.482** (0.111)	0.620** (0.083)
σ	11,758	10,921
N	2,263	1,732

SOURCES: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

NOTE: The dependent variable is the sum of the money value of food used at home, amount spent on food away from home, and the subsidy value of school breakfasts and lunches, scaled on the basis of the number of adult-male-equivalent persons, based upon 1980 RDA for food energy. The food expenditure equations were estimated jointly with FSP and NAP participation equations (see Table C.4). All dollar-denominated variables were in constant (1984) dollars. Weighted data were used.

^aThis equation was estimated on all households in the 1984 data file that would have been eligible for the 1977 Food Stamp Program, after adjusting for inflation.

*Significant at the .05 level, two-tailed test.

**Significant at the .01 level, two-tailed test.

TABLE C.4

FSP AND NAP PARTICIPATION EQUATIONS FOR
FSP- OR NAP-ELIGIBLE PUERTO RICO HOUSEHOLDS,
ESTIMATED JOINTLY WITH TOTAL FOOD EXPENDITURE EQUATIONS

(standard errors in parentheses)

Explanatory Variables	1977	1984 ^a
Constant	0.818** (0.121)	1.176** (0.155)
Household Weekly Money Income	-0.005** (0.0003)	-0.005** (0.0006)
Household Potential Weekly Food Assistance Benefit	0.018** (0.002)	0.015** (0.003)
Nonmetropolitan	0.161* (0.064)	0.240** (0.079)
Black	0.251** (0.095)	0.077 (0.113)
Male Head of Household Only	-0.210 (0.143)	0.092 (0.202)
Female Head of Household Only	0.041 (0.084)	0.044 (0.090)
Own Home	-0.175* (0.075)	-0.485** (0.098)
Head of Household is 35 to 59 Years Old ^b	-0.310** (0.079)	-0.261* (0.108)
Head of Household is 60 Years Old or Over ^b	-0.537** (0.103)	-0.641** (0.123)
Head of Household Completed High School ^b	-0.401** (0.077)	-0.398** (0.093)
Male Head Employed	-0.466** (0.072)	-0.243** (0.093)
Female Head Employed	-0.279** (0.083)	-0.142 (0.121)
ρ^c	-0.032 (0.042)	-0.005 (0.049)
N	2,263	1,303

SOURCES: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

NOTES: The FSP and NAP participation equations were estimated jointly with total food expenditure equations for 1977 and 1984 (see Table C.3). The dependent variable in the participation equation takes on a value of 1 for recipients of food assistance and 0 for eligible nonrecipients. The resultant coefficients can be interpreted as if they were probit estimates. All dollar-denominated variables were in constant (1984) dollars. Weighted data were used.

^aNote that the 1984 participation equation was estimated on NAP-eligible households, while the 1984 total food expenditure equation was estimated on FSP-eligible households.

^bThe household head is the female head if one is present, otherwise it is the male head.

^cThe estimate of ρ is the correlation between the error term in the participation equation and the error term in the total food expenditure equation. The 1984 estimate of ρ is based upon NAP-eligible households only.

*Significant at the .05 level, two-tailed test.

**Significant at the .01 level, two-tailed test.

the coefficient on the potential food assistance benefit which is positive and the coefficient on money income which is negative. An interesting result in Table C.4 is the small and insignificant coefficient for p , which is the correlation between the disturbance terms of the food expenditure and participation equations. This finding suggests that there is no self-selection bias associated with estimating a food expenditure equation that does not account for any systematic differences in food expenditures between participants and eligible nonparticipants.

Tables C.5 and C.6 present the results of the analysis of the money value of food used at home. For the most part, these findings are similar to those for total food expenditures. One difference is that the MPC out of coupons is slightly higher than the MPC out of cash benefits (.268 versus .210), suggesting that slightly more of an additional dollar of coupon benefits is spent on food at home than of an additional dollar of cash benefits. This difference, however, is not significantly different from zero.

The results of the participation equation are similar to those discussed above. Most of the parameter estimates have the expected sign, except for the estimate of p in 1977 which is negative. This parameter estimate is not significant at the .01 or .05 level, but it is significant at the .10 level. In addition, its negative sign is what drives the estimated coefficient on coupon benefits up to .268, as shown in Table C.5.

B. ECONOMETRIC ANALYSIS OF NUTRIENT AVAILABILITY

The model of nutrient availability that is described in Chapter IV of this report is an integral component of a larger model of the effects of

TABLE C.5

ESTIMATES OF MONEY-VALUE-OF-FOOD-USED-AT-HOME EQUATIONS
FOR FOOD-STAMP-ELIGIBLE PUERTO RICO HOUSEHOLDS

(standard errors in parentheses)

Explanatory Variables	1977	1984 ^a
Constant	27.551** (1.422)	25.861** (1.530)
Household Weekly Money Income per Adult Male Equivalent	0.138** (0.012)	0.164** (0.012)
Household Weekly Food Benefit per Adult Male Equivalent	0.268** (0.047)	0.210** (0.048)
Weekly Subsidy Value of School Breakfasts per Adult Male Equivalent	0.657 (0.943)	1.373 (0.796)
Weekly Subsidy Value of School Lunches per Adult Male Equivalent	0.600** (0.218)	0.432 (0.232)
Weekly Value of Home Grown Food per Adult Male Equivalent	1.230** (0.120)	1.456* (0.104)
Weekly Value of Gift/Pay Food per Adult Male Equivalent	1.157** (0.091)	1.427** (0.094)
Female Head Present	4.319** (1.986)	-0.142 (1.036)
Black	-1.191* (0.771)	-2.228* (0.885)
Number of Adult-Male-Equivalent Persons	-2.815** (0.180)	-2.382** (0.224)
Number of Guest Meals per Adult Male Equivalent	0.457** (0.109)	0.492** (0.086)
G	11.527	11.169
N	2,263	1,732

SOURCES: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

NOTE: The dependent variable is the household weekly money value of food used at home, scaled on the basis of the number of "equivalent nutrition units" eating meals from home food supplies, based upon 1980 RDA for food energy. The explanatory variables were scaled on the basis of the number of adult-male-equivalent persons. The food-at-home equations were estimated jointly with FSP and MAP participation equations (see Table C.6). All dollar-denominated variables were in constant (1984) dollars. Weighted data were used.

^aThis equation was estimated on all households in the 1984 data file that would have been eligible for the 1977 Food Stamp Program, after adjusting for inflation.

*Significant at the .05 level, two-tailed test.

**Significant at the .01 level, two-tailed test.

TABLE C.6

FSP AND NAP PARTICIPATION EQUATIONS FOR FSP- OR
NAP-ELIGIBLE PUERTO RICO HOUSEHOLDS, ESTIMATED
JOINTLY WITH FOOD-AT-HOME EQUATIONS

(standard errors in parentheses)

Explanatory Variables	1977	1984 ^a
Constant	0.817** (0.121)	1.178** (0.155)
Household Weekly Money Income	-0.005** (0.0003)	-0.005** (0.0006)
Household Potential Weekly Food Assistance Benefit	0.018** (0.002)	0.015** (0.003)
Nonmetropolitan	0.158* (0.064)	0.242** (0.079)
Black	0.250** (0.095)	0.078 (0.113)
Male Head of Household Only	-0.211 (0.142)	0.095 (0.201)
Female Head of Household Only	0.048 (0.084)	0.043 (0.090)
Own Home	-0.176* (0.075)	-0.487** (0.098)
Head of Household is 35 to 59 Years Old ^b	-0.307** (0.079)	-0.265* (0.108)
Head of Household is 60 Years Old or Over ^b	-0.528** (0.103)	-0.646** (0.123)
Head of Household Completed High School ^b	-0.399** (0.077)	-0.398** (0.093)
Male Head Employed	-0.463** (0.072)	-0.246** (0.094)
Female Head Employed	-0.270** (0.083)	-0.145 (0.122)
ρ^c	-0.066 (0.040)	0.012 (0.048)
N	2,263	1,303

SOURCES: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey; 1984 Puerto Rico Household Food Consumption Survey.

NOTES: The FSP and NAP participation equations were estimated jointly with food-at-home equations for 1977 and 1984 (see Table C.5). The dependent variable in the participation equation takes on a value of 1 for recipients of food assistance and 0 for eligible nonrecipients. The resultant coefficients can be interpreted as if they were probit estimates. All dollar-denominated variables were in constant (1984) dollars. Weighted data were used.

^aNote that the 1984 participation equation was estimated on NAP-eligible households, while the 1984 food-at-home equation was estimated on FSP-eligible households.

^bThe household head is the female head if one is present, otherwise it is the male head.

^cThe estimate of ρ is the correlation between the error term in the participation equation and the error term in the food-at-home equation. The 1984 estimate of ρ is based upon NAP-eligible households only.

*Significant at the .05 level, two-tailed test.

**Significant at the .01 level, two-tailed test.

food assistance benefits on the money value of food used at home and nutrient availability. The full model consists of two principal parts:

- (1) An equation explaining the money value of food used at home: $F = f(B, X)$ ¹
- (2) Equations explaining the availability of food energy and five nutrients: $N_j = g_j(F, Y)$

where F is the money value of food used at home, BEN is the food assistance benefit, N_j is the availability of nutrient j , and X and Z are vectors of other variables that affect the money value of food used at home and nutrient availability, respectively.

Data limitations require that the full model be specified in terms of food used at home; the 1977 and 1984 data files provide information on nutrient availability that is based only on food used at home, rather than total food used.

As shown, the full model of the effects of food assistance benefits consists of a food expenditure equation and a block of six nutrient availability equations. The model is block recursive in that the money value of food at home appears as an explanatory variable in the nutrient availability equations, but the measures of nutrient availability do not appear as explanatory variables in the food expenditure equation. This structure is consistent with the assumption discussed in Chapter IV that changes in food assistance benefits affect nutrient availability only indirectly via changes in the money value of food used at home. The block

¹As discussed in Section A, the equation explaining the money value of food used at home is estimated jointly with an equation explaining the program participation decision.

recursive structure facilitates estimation by permitting the detailed modeling of the effects of food assistance benefits to be confined to the food-at-home block.

The six equations in the nutrient-availability block of the full model explain the daily availability per equivalent nutrition unit of food energy, vitamin B₆, vitamin A, magnesium, calcium, and iron. Each equation has the same set of explanatory variables--the F and Y variables mentioned above:

- o The money value of food used at home per equivalent nutrition unit (F)
- o The race of the survey respondent
- o An indicator of whether the household has only a male head
- o An indicator of whether the household has only a female head
- o Indicators of the age of the female household head (or male head if no female head is present)¹
- o An indicator of whether the female household head (or male head if no female head is present) completed high school
- o The employment status of the male head
- o The employment status of the female head
- o An indicator of whether the household owns its home

Sample mean values of these explanatory variables for FSP-eligible households in 1977 and 1984 are provided in Table C.7.

¹For variables referring only to one household head, the characteristics of the female head are included in the analysis because in most of the sample households she is responsible for purchasing food and preparing meals.

TABLE C.7

MEAN VALUES OF EXPLANATORY VARIABLES IN EQUATIONS EXPLAINING THE
 AVAILABILITY OF SELECTED NUTRIENTS IN FOOD USED FROM HOME
 FOOD SUPPLIES BY FOOD-STAMP-ELIGIBLE PUERTO RICO HOUSEHOLDS

	1977	1984
Money Value of Food Used at Home Per Equivalent Nutrition Unit ^a	\$4.42	\$4.23
Black	0.12	0.12
Male Head of Household Only	0.04	0.04
Female Head of Household Only	0.23	0.31
Head of Household is 35 to 59 Years Old ^b	0.51	0.47
Head of Household is 60 Years Old or Over ^b	0.23	0.32
Head of Household Completed High School ^b	0.22	0.27
Male Head Employed	0.38	0.30
Female Head Employed	0.13	0.12
Own Home	0.74	0.75
N	2,263	1,732

SOURCES: 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey;
 1984 Puerto Rico Household Food Consumption Survey.

NOTE: Weighted data were used.

^aThe money value of food used at home per equivalent nutrition unit (computed on the basis of 1980 RDA for food energy) is a daily measure in constant (1984) dollars.

^bThe household head is the female head if one is present, otherwise it is the male head.

Equations in both blocks of the full model are assumed to include random disturbance terms. If the disturbance term in the food expenditure equation is correlated with the disturbance terms in the nutrient availability equations, then ordinary regression estimates of the effect of food at home on nutrient availability would be biased. To avoid this problem, the money value of food used at home is replaced in the nutrient availability equations by an instrument for this variable. That is, it is replaced by the predicted money value of food used at home, based upon estimation results from the food expenditure analysis. This instrument is purged of any correlation with the disturbance terms in the nutrient availability equations. With this adjustment, regression analysis can produce consistent estimates of the nutrient availability equations.

Regression estimates of the nutrient availability equations for FSP eligible households in 1977 and 1984 are presented in Tables C.8 and C.9, respectively. The most consistent finding is that the money value of food used at home has a positive and significant effect on nutrient availability. This effect appears to have grown somewhat over the 1977-1984 period.

Implications of the regression estimates for the effects of cash issuance and NAP's restrictions on eligibility and benefits are developed in Tables C.10 to C.12. In these tables, FIML estimates are used to assess the effects of NAP on the money value of food used at home. Regression estimates of the nutrient availability equations are used to assess the effects of the estimated changes in the money value of food used at home on nutrient availability. In this indirect way, the effects of NAP on nutrient availability are assessed. This procedure is applied to several "representative" households and should not be confused with the full-scale

TABLE C.9

ESTIMATES OF EQUATIONS EXPLAINING THE AVAILABILITY OF FOOD
ENERGY AND SELECTED NUTRIENTS IN FOOD USED FROM HOME FOOD
SUPPLIES BY FOOD-STAMP-ELIGIBLE PUERTO RICO HOUSEHOLDS IN 1984

(standard errors in parentheses, N = 1,732)

Explanatory Variables	Food Energy (Kcal)	Vitamin B ₆ (mg)	Vitamin A ^a (IU)	Magnesium (mg)	Calcium (mg)	Iron (mg)
Constant	881.055** (188.896)	0.585** (0.121)	7.813** (0.067)	99.957** (23.276)	231.999** (56.691)	2.701** (0.935)
Predicted Money Value of Food Used at Home per Equivalent Nutrition Unit ^b	781.383** (36.235)	0.515** (0.023)	0.205** (0.013)	105.519** (4.465)	197.377** (10.875)	3.505** (0.179)
Black	57.672 (127.265)	-0.054 (0.081)	-0.013 (0.044)	-13.923 (15.681)	-68.318 (38.195)	0.148 (0.630)
Male Head of Household Only	-153.338 (224.575)	0.043 (0.144)	-0.200** (0.077)	23.200 (27.672)	101.107 (67.339)	3.111** (1.111)
Female Head of Household Only	223.037* (102.596)	0.045 (0.066)	0.018 (0.036)	7.351 (12.642)	-24.994 (30.791)	-1.279* (0.508)
Head of Household is 35 to 59 Years Old ^c	202.086 (114.382)	0.153* (0.073)	0.004 (0.040)	19.224 (14.094)	16.174 (34.328)	1.810** (0.566)
Head of Household is 60 Years Old or Over ^c	247.785 (136.570)	-0.085 (0.087)	-0.048 (0.048)	9.574 (16.828)	87.503* (40.987)	4.182** (0.676)
Head of Household Completed High School ^c	-414.158** (101.551)	-0.129* (0.064)	0.053 (0.035)	-60.077** (12.513)	-35.266 (30.477)	-2.837** (0.503)
Male Head Employed	-29.590 (102.981)	0.035 (0.066)	0.014 (0.036)	-2.500 (12.689)	-7.906 (30.907)	-0.781 (0.510)
Female Head Employed	46.906 (132.561)	0.110 (0.085)	0.034 (0.044)	5.920 (16.334)	34.136 (39.784)	-0.304 (0.656)
Own Home	314.124** (101.004)	0.118 (0.065)	-0.042 (0.035)	39.476** (12.446)	62.469* (30.313)	1.432** (0.500)
R ²	0.277	0.250	0.151	0.303	0.217	0.305

SOURCE: 1984 Puerto Rico Household Food Consumption Survey.

NOTES: The dependent variables are daily measures per 21-meal-at-home-adult-male-equivalent person. The number of equivalent adult males eating from home food supplies was computed separately for each nutrient, using nutrient-specific RDA.

^aThe dependent variable in this equation is the natural logarithm of the availability of vitamin A.

^bThe money value of food used at home per equivalent nutrition unit (computed on the basis of 1980 RDA for food energy) is a daily measure that was predicted on the basis of FIML estimates of the food-at-home equation that are shown in Table C.5.

^cThe household head is the female head if one is present; otherwise it is the male head.

*Significant at the .05 level, two-tailed test.

**Significant at the .01 level, two-tailed test.

TABLE C.10

IMPLIED EFFECTS OF CASH ISSUANCE ON NUTRIENT AVAILABILITY
FOR A TYPICAL HOUSEHOLD, BASED ON STATISTICAL ESTIMATES

Assumptions:

- (1) Nutrient availability under NAP is being compared with nutrient availability under the hypothetical "Coupon Program."
- (2) The "typical" household is assumed to receive a daily benefit of \$1.63 per adult male equivalent under both NAP and the "Coupon Program." This is the average reported NAP benefit in 1984.

Estimated Effect on the Daily Money Value of Food Used at Home per Equivalent Nutrition Unit:

$$\begin{aligned}
 \text{Change in Money Value of Food Used at Home} &= (\text{MPC}_{\text{NAP}} - \text{MPC}_{\text{FSP}}) \times \text{Daily Benefit} \\
 &= (.21 - .27) \times \$1.63 \\
 &= -\$.10
 \end{aligned}$$

Estimated Effects on the Daily Availability of Nutrients from Food Used at Home per Equivalent Nutrition Unit:

Change in Availability of Nutrient	= Change in Money Value of Food Used at Home	x Estimated Effect of Food at Home on Nutrient Availability in 1984
o Change in Availability of Food Energy	= $-\$.10 \times 781$	= -78 Kcal (-2.9%)
o Change in Availability of Vitamin B ₆	= $-\$.10 \times 0.52$	= -0.05 mg (-2.3%)
o Change in Availability of Vitamin A	= $-\$.10 \times 1,470$	= -147 IU (-2.9%)
o Change in Availability of Magnesium	= $-\$.10 \times 106$	= -10.6 mg (-3.0%)
o Change in Availability of Calcium	= $-\$.10 \times 197$	= -19.7 mg (-2.5%)
o Change in Availability of Iron	= $-\$.10 \times 3.5$	= -0.35 mg (-3.5%)

NOTE: Percentage changes in nutrient availability are relative to the adult male RDA (see Table IV.5).

TABLE C.11

IMPLIED EFFECTS OF RESTRICTIONS ON PROGRAM BENEFITS
ON NUTRIENT AVAILABILITY FOR A TYPICAL HOUSEHOLD,
BASED ON STATISTICAL ESTIMATES

Assumptions:

- (1) Nutrient availability under NAP is being compared with nutrient availability under the hypothetical "Cash Program."
- (2) The "typical" household is assumed to receive the average daily NAP benefit of \$1.63 per adult male equivalent. This is average reported NAP benefit in 1984. Under the "Coupon Program," the benefit is assumed to be \$1.89 (16 percent higher) due to indexation for changes in food prices.

Estimated Effect on the Daily Money Value of Food Used at Home per Equivalent Nutrition Unit:

$$\begin{aligned}
 \text{Change in Money Value of Food Used at Home} &= \text{MPC}_{\text{NAP}} \times (\text{Daily NAP Benefit} - \text{Daily "Coupon Program" Benefit}) \\
 &= .21 \times (\$1.63 - \$1.89) \\
 &= -\$0.05
 \end{aligned}$$

Estimated Effects on the Daily Availability of Nutrients from Food Used at Home per Equivalent Nutrition Unit:

Change in Availability of Nutrient	Change in Money Value of Food Used at Home	x	Estimated Effect of Food at Home on Nutrient Availability in 1984
o Change in Availability of Food Energy	= $-\$0.05 \times 781$	=	-39 Kcal (-1.4%)
o Change in Availability of Vitamin B ₆	= $-\$0.05 \times 0.52$	=	-0.03 mg (-1.4%)
o Change in Availability of Vitamin A	= $-\$0.05 \times 1,470$	=	-74 IU (-1.5%)
o Change in Availability of Magnesium	= $-\$0.05 \times 106$	=	-5.3 mg (-1.5%)
o Change in Availability of Calcium	= $-\$0.05 \times 197$	=	-9.9 mg (-1.2%)
o Change in Availability of Iron	= $-\$0.05 \times 3.5$	=	-.18 mg (-1.8%)

NOTE: Percentage changes in nutrient availability are relative to the adult male RDA (see Table IV.5).

TABLE C.12

IMPLIED EFFECTS OF RESTRICTIONS ON PROGRAM ELIGIBILITY
ON NUTRIENT AVAILABILITY FOR A TYPICAL HOUSEHOLD,
BASED ON STATISTICAL ESTIMATES

Assumptions:

- (1) Nutrient availability under NAP is being compared with nutrient availability under the hypothetical "Cash Program."
- (2) The "typical" household is assumed to be ineligible for NAP and is assumed to receive a daily benefit under the "Cash Program" of \$1.18 per adult male equivalent. This NAP-ineligible household has a small benefit under the "Cash Program" (relative to the NAP-eligible household in Table IV.7) because its net income is relatively high.

Estimated Effect on the Daily Money Value of Food Used at Home per Equivalent Nutrition Unit:

$$\begin{aligned}
 \text{Change in Money Value of Food Used at Home} &= \text{MPC}_{\text{NAP}} \times (\text{Daily NAP Benefit} - \text{Daily "Coupon Program" Benefit}) \\
 &= .21 \times (\$0.00 - \$1.18) \\
 &= -\$0.25
 \end{aligned}$$

Estimated Effects on the Daily Availability of Nutrients from Food Used at Home per Equivalent Nutrition Unit:

Change in Availability of Nutrient	= Change in Money Value of Food Used at Home	x Estimated Effect of Food at Home on Nutrient Availability in 1984
o Change in Availability of Food Energy	= $-\$0.25 \times 781$	= -195 Kcal (-7.2%)
o Change in Availability of Vitamin B ₆	= $-\$0.25 \times 0.52$	= -0.13 mg (-5.9%)
o Change in Availability of Vitamin A	= $-\$0.25 \times 1,470$	= -368 IU (-7.4%)
o Change in Availability of Magnesium	= $-\$0.25 \times 106$	= -26.5 mg (-7.6%)
o Change in Availability of Calcium	= $-\$0.25 \times 197$	= -49.3 mg (-6.2%)
o Change in Availability of Iron	= $-\$0.25 \times 3.5$	= -0.88 mg (-8.8%)

NOTE: Percentage changes in nutrient availability are relative to the adult male RDA (see Table IV.5).

simulation analysis of nutrient availability that is described in Chapter IV and in the following section. Highlights of NAP's estimated effects on nutrient availability, as reported in Tables C.10 to C.12, are as follows:

- o For a NAP participant receiving the average benefit, cash issuance is estimated to have reduced the availability of food energy by 2.9 percent and the availability of five nutrients by between 2.3 percent and 3.5 percent (Table C.10).
- o For a NAP participant receiving the average benefit, NAP's restrictions on benefits are estimated to have reduced the availability of food energy by 1.4 percent and the availability of five nutrients by between 1.2 percent and 1.8 percent (Table C.11).
- o For the average FSP participant who was ineligible to receive NAP benefits, the availability of food energy fell by 7.2 percent and the availability of five nutrients fell by between 5.9 percent and 8.8 percent (Table C.12).

C. SIMULATION ANALYSIS

As applied in this study, simulation analysis involves the use of estimates of equations explaining food use, participation in a food assistance program, and nutrient availability to predict these outcomes for individual sample households under alternative sets of program regulations. The predicted outcomes under one set of program rules can be averaged over the sample and compared to average predicted outcomes under another set of regulations, thus providing an estimate of the effect of the regulation changes on food expenditures and nutrient availability.

Household program participation, food expenditures, and nutrient availability were simulated under three alternative programs. The programs and the equations used in the simulations are as follows:

Program 1 - NAP

$$(a) \quad P_1^* = Z_{84} \delta_{84} + \gamma_{84} \text{NAP}_{84}$$

$$(b) \quad F_1 = X_{84} \beta_{84} + \alpha_{84} \text{NAP}_{84} \times P_1$$

$$(c) \quad \text{NA}_1 = Y_{84} \lambda_{84} + \theta_{84} F_1$$

Program 2 - A hypothetical "Coupon Program" that provides NAP-level benefits in the form of coupons

$$(a) \quad P_2^* = Z_{84} \delta_{84} + \gamma_{77} \text{NAP}_{84}$$

$$(b) \quad F_2 = X_{84} \beta_{84} + \alpha_{77} \text{NAP}_{84} \times P_2$$

$$(c) \quad \text{NA}_2 = Y_{84} \lambda_{84} + \theta_{84} F_2$$

Program 3 - A hypothetical "Cash Program" that provides FSP-level benefits in the form of cash and has FSP eligibility requirements

$$(a) \quad P_3^* = Z_{84} \delta_{84} + \gamma_{84} \text{FSP}_{84}$$

$$(b) \quad F_3 = X_{84} \beta_{84} + \delta_{84} \text{FSP}_{84} \times P_3$$

$$(c) \quad \text{NA}_3 = Y_{84} \lambda_{84} + \theta_{84} F_3$$

The notation in the equations is defined as follows:

δ_{84} The vector of coefficients on household characteristics in the 1984 program participation equation

$\gamma_{77} \quad (\gamma_{84})$ The coefficient on the actual or potential food assistance benefit in the 1977 (1984) program participation equation

β_{84} The vector of coefficients on household characteristics in the 1984 food expenditure equation

$\alpha_{77} \ (\alpha_{84})$	The coefficient on the actual food assistance benefit in the 1977 (1984) food expenditure equation
λ_{84}	The vector of coefficients on household characteristics in a selected 1984 nutrient availability equation
θ_{84}	The coefficient on food expenditures (specifically, the money value of food used at home) in a selected 1984 nutrient availability equation
$P_1^* \ (P_2^*, P_3^*)$	The simulated value of the participation index under Program 1 (Program 2 or Program 3)
$P_1 \ (P_2, P_3)$	An indicator of simulated participation status (0 = nonparticipation, 1 = participation) under Program 1 (Program 2 or Program 3)
$F_1 \ (F_2, F_3)$	Simulated food expenditures under Program 1 (Program 2 or Program 3)
$NA_1 \ (NA_2, NA_3)$	Simulated availability of a selected nutrient under Program 1 (Program 2 or Program 3)
Z_{84}	A vector of household characteristics, measured in 1984, that affect program participation
X_{84}	A vector of household characteristics, measured in 1984, that affect food expenditures
Y_{84}	A vector of household characteristics, measured in 1984, that affect the availability of a selected nutrient
NAP_{84}	The potential 1984 NAP benefit
FSP_{84}	The potential 1984 FSP benefit if the FSP had continued to exist in 1984

- NOTES: (1) Only one selected nutrient availability equation is shown from among six such equations.
- (2) The simulated benefit amount received by a household is given by the interaction of the potential benefit and the simulated participation status (P).
- (3) In simulating nutrient availability, the measure of food expenditures is the money value of food used at home.

Heuristically, the effects of cash issuance on food expenditures are nutrient availability are given by $F_1 - F_2$ and $NA_1 - NA_2$, while the effects of restrictions on eligibility and benefits are given by $F_1 - F_3$ and $NA_1 - NA_3$.

Two pairs of simulations were conducted: (1) simulation of outcomes under the "Coupon Program" and NAP, and (2) simulation of outcomes under the "Cash Program" and NAP. Tables C.13 and C.14 provide step-by-step descriptions of the procedures for simulating total food expenditures under these two pairs of programs. The procedures for simulating the money value of food used at home are exactly analogous to these. Simulation of nutrient availability requires the replacement of Step 5 in the simulation of the money value of food used at home with the following two steps:

5. To simulate nutrient availability, regression estimates of equations explaining the availability of food energy and the five selected nutrients are applied to reported household characteristics and the predicted money value of food used at home. The result is the predicted availability of food energy and nutrients under the program being studied.
6. For each household, predicted nutrient availability is compared to the RDA. Based on results for all households in the simulation, the percentages of households that fail to attain the RDA for food energy and the five selected nutrients are computed.

TABLE C.13

PROCEDURE FOR SIMULATING THE EFFECT OF
CASH ISSUANCE ON TOTAL FOOD EXPENDITURES

-
- A. Using the 1984 data file, total food expenditures are simulated under the hypothetical "Coupon Program."
1. Eligibility requirements are assumed to be the same under the "Coupon Program" as under NAP. Eligibility of households in the 1984 file for the "Coupon Program" is determined by comparing reported incomes to NAP eligibility limits.^a
 2. Benefit amounts are assumed to be the same as under NAP; however, the benefits are in the form of coupons.^b
 3. The 1984 statistical estimates of the determinants of participation in NAP are used to determine the probability of participation in the "Coupon Program" for each eligible household. However, because benefits are in the form of coupons rather than cash, the statistical estimate of the effect of cash benefits on participation is replaced by the statistical estimate of the effect of coupon benefits on participation.^c
 4. The 1984 statistical estimates of the determinants of total food expenditures are used to predict expenditures by each household that is predicted to participate in the "Coupon Program." However, because benefits are in the form of coupons rather than cash, the statistical estimate of the MPC out of cash benefits is replaced by the estimated MPC out of coupons from the statistical analysis of the 1977 data.^d
 5. The average predicted total food expenditure is computed for predicted participants in the "Coupon Program."
- B. Again using 1984 data, total food expenditures of predicted participants in the hypothetical "Coupon Program" are simulated under the assumption that the "Coupon Program" is replaced by NAP.
1. Because the "Coupon Program" and NAP have the same eligibility requirements, all of the target households (predicted participants in the "Coupon Program") are eligible for NAP.^a
 2. Benefits are assumed to be in the form of cash and in NAP amounts.^b

TABLE C.13 (Continued)

3. The 1984 statistical estimates of the determinants of program participation (including the estimated effect of cash benefits) are used to determine the probability of participation in NAP for each target household.^c
4. The 1984 statistical estimates of the determinants of total food expenditures (including the estimated MPC out of cash benefits) are used to predict expenditures by each target household under NAP.^d
5. The average predicted total food expenditure under NAP is computed for target households. This amount is compared to the average predicted expenditure of the same households under the "Coupon Program" to obtain an estimate of the effect of cash issuance on total food expenditures.

^aComplete information on deductions from gross income is not available in the 1984 survey data file. In lieu of this information, a household's deductions are assumed to equal a proportion of its gross income. The proportion is the average deduction rate, by household size, reported in the June 1984 Puerto Rico master case record file. For elderly households, net income eligibility for NAP and the "Coupon Program" is determined by applying the estimated deduction rate to reported gross income and comparing the resultant estimated net income with the NAP net income limits. Gross income eligibility for both programs is determined by a direct comparison of reported gross income to the NAP gross income limits.

^bAll eligible households are assigned a potential NAP or "Coupon Program" benefit. For reported participants in NAP, the amount of the potential benefit is set equal to the reported amount of the NAP benefit. Potential benefits for all other households are assigned on the basis of an estimated NAP benefit equation. Regression analysis was used to estimate this equation.

^cA "disturbance term" randomly selected from the standard normal distribution is assigned to each household in the 1984 data file. Each eligible household's disturbance term is compared to its predicted probability of participating (actually, to its predicted participation index) in the program being studied. If the disturbance term is the smaller of the two, then the household is selected as a simulated participant in that program.

^dTo preserve the variation across households that is observed in reported total food expenditures, the predicted value of total food expenditures is specified to include a disturbance term. This term, which is equal to each household's residual in the estimated total food expenditure equation, is included in the predictions of total food expenditures under the "Coupon Program" and NAP.

TABLE C.14

PROCEDURE FOR SIMULATING THE EFFECT OF RESTRICTIONS ON
ELIGIBILITY AND BENEFITS ON TOTAL FOOD EXPENDITURES

-
- A. Using the 1984 data file, total food expenditures are simulated under the hypothetical "Cash Program."
1. Eligibility requirements are assumed to be less restrictive under the "Cash Program" than under NAP. These requirements are found by adjusting 1977 FSP eligibility requirements for inflation.^a
 2. Benefits are assumed to be in the form of cash and to be approximately 16 percent larger under the "Cash Program" than under NAP--equal to projected FSP benefits in 1984.^b
 3. The 1984 statistical estimates of the determinants of participation in NAP are used to determine the probability of participation in the "Cash Program" for each eligible household.^c
 4. The 1984 statistical estimates of the determinants of total food expenditures are used to predict expenditures by each household that is predicted to participate in the "Cash Program."^d
 5. The average predicted total food expenditure is computed for predicted participants in the "Cash Program."
- B. Again using 1984 data, total food expenditures of predicted participants in the hypothetical "Cash Program" are simulated under the assumption that the "Cash Program" is replaced by NAP.
1. The more restrictive NAP eligibility criteria are applied to the target households (predicted participants in the "Cash Program").^a
 2. Benefits are assumed to be in the form of cash and in NAP amounts.^b
 3. The 1984 statistical estimates of the determinants of program participation are used to determine the probability of participation in NAP for each NAP-eligible target household.^c
 4. The 1984 statistical estimates of the determinants of total food expenditures are used to predict expenditures by each target household under NAP.^d
 5. The average predicted total food expenditure under NAP is computed for target households. This amount is compared to the average predicted expenditure of the same households under the "Cash Program" to obtain an estimate of the effect of restrictions on eligibility and benefits on total food expenditures.
-

TABLE C.14 (Continued)

^aComplete information on deductions from gross income is not available in the 1977 and 1984 survey data files. In lieu of this information, a household's deductions are assumed to equal a proportion of its gross income. The proportion is the average deduction rate, by household size, computed from FSP quality control data for 1978 and from the June 1984 Puerto Rico master case record file. For elderly households, net income eligibility for NAP is determined by applying the 1984 deduction rate to reported gross income in the 1984 survey data file and comparing the resultant estimated net income with the NAP net income limits. Net income eligibility for the FSP is determined by applying the 1978 deduction rate to reported gross income in the 1984 survey data file and comparing the resultant estimated net income with 1977 FSP net income limits measured in 1984 dollars. Gross income eligibility for these programs is determined by direct comparisons of reported gross income to the actual NAP gross income limits and the inflation-adjusted FSP limits.

^bHouseholds eligible for NAP are assigned a potential NAP benefit equal to the reported NAP benefit (if available) or to the predicted benefit based on an estimated NAP benefit equation. Regression analysis was used to estimate this equation on a sample of NAP participants. Household eligible for the FSP are assigned a FSP benefit equal to 1.1577 times their assigned potential NAP benefit. The adjustment factor accounts for the indexation of FSP maximum benefits that would have occurred subsequent to June 1982 if the FSP had remained in effect. See Chapter I for details.

^cA "disturbance term" randomly selected from the standard normal distribution is assigned to each household in the 1984 data file. The disturbance term for each household that is eligible for NAP or the "Cash Program" is compared to its predicted probability of participation (actually, to its predicted participation index) in the program being studied. If the disturbance term is the smaller of the two, then the household is selected as a simulated participant in that program.

^dTo preserve the variation across households that is observed in reported total food expenditures, the predicted value of total food expenditures is specified to include a disturbance term. This term, which is equal to each household's residual in the estimated total food expenditure equation, is included in the predictions of total food expenditures under the "Cash Program" and NAP.

APPENDIX D

ANALYSIS OF THE POSSIBILITY OF EFFECTS
OF THE ELIMINATION OF THE FOOD STAMP
PURCHASE REQUIREMENT

The evaluation of the effects of NAP on food expenditures in Puerto Rico, which is presented in the body of this report, is based upon two surveys, one administered in 1977 and one in 1984. NAP effects are derived, directly or indirectly, by comparisons between the values of food expenditures in the two survey years, by comparisons of regression coefficients on variables in food-expenditure equations estimated in the two years, and by comparison of simulated food expenditures under NAP and two hypothetical programs that combine aspects of NAP and the FSP. While such comparisons provide information on expenditure behavior both prior to and following the implementation of NAP, the pre-NAP 1977 survey was administered before another major change in the FSP--the elimination of the purchase requirement (EPR) in 1979. As both EPR and the introduction of NAP occurred between 1977 and 1984, the comparison of 1977 and 1984 results to provide an indication of the effects of NAP may be misleading since any differences in the results may be due in part to EPR. This possibility is of particular concern since the expectation is that EPR should have reduced food expenditures--exactly the type of effect that was predicted for NAP.

To determine the extent to which EPR affected food expenditures, the 1977 survey data were investigated. By relying on the fact that different individuals have different purchase requirements, it is possible, conceptually, to determine the effect of purchase requirements on food expenditures. By extrapolation, the effect of the elimination of the purchase requirement on food expenditures can be predicted, for EPR is, as a first approximation, simply a reduction of the purchase requirement to zero.

The impact of a purchase requirement on food expenditures is complex, as the purchase requirement could have two different effects on

EPR would be expected to come from those households which were consuming exactly their food stamp allotment before EPR--that is, those households at the "kink" of their budget constraint.

The statistical model used to estimate the effects of the purchase requirement on food expenditures assumes that households make a choice among the three pre-EPR participation categories, as well as choosing whether or not to participate in the FSP at all. The model simultaneously eliminates the self-selectivity bias that would arise from participation in the program as well as the self-selectivity bias that would arise from the choice of one of the three categories of program participation.

The estimation of the model on the basis of the 1977 data failed to reveal any effects of the purchase requirement on food expenditures. Three different food expenditure equations were investigated as part of this estimation:

$$(1) \quad F = a + bP + cY + dB$$

$$(2) \quad \log F = a + b (\log P) + c (\log Y) + d (\log B)$$

$$(3) \quad PF = a + bP + cY + dB$$

where

F = food expenditure per adult male equivalent or equivalent nutrition unit,

P = ratio of the purchase requirement to the food stamp allotment,

Y = cash income per adult male equivalent, and

B = food stamp bonus per adult male equivalent.

In equation (1), food expenditure is a linear function of the ratio of the purchase requirement to the food stamp allotment, cash income, and

the food stamp bonus. In equation (2), the logarithm of food expenditure is a function of the logarithms of the three variables included in equation (1). This form of the model is realistic if households change their food expenditures by a given percentage in response to a given percentage change in the ratio of the purchase requirement to the food stamp allotment, cash income, or the food stamp bonus. The third equation assumes that households choose the product of food expenditure and the ratio of the purchase requirement to the food stamp allotment--which equals the households' food expenditures from their own income. This own food expenditure is assumed to be a function of the ratio of the purchase requirement to the cash income, and the food stamp allotment, food stamp bonus (this specification is the Stone-Geary or linear-expenditure-system form).

The estimation of the model failed to reveal any impact of the purchase requirement on food expenditures as there was not a detectable number of households consuming at the kink of their budget constraint and, as noted above, very few households in the survey reported being partial participants.¹ If there had been a large number of households at the kink, this would appear in the data as a clustering of values for households' food expenditures around the value of the households' food stamp allotments.

Estimation of the model required the determination of a "clustering parameter" (the standard deviation of the distribution of the population), the estimate of which is based upon the underlying amount of clustering

¹Given that there is no effect of EPR found for food expenditures, the expected impact of EPR on nutrient availability is also zero.

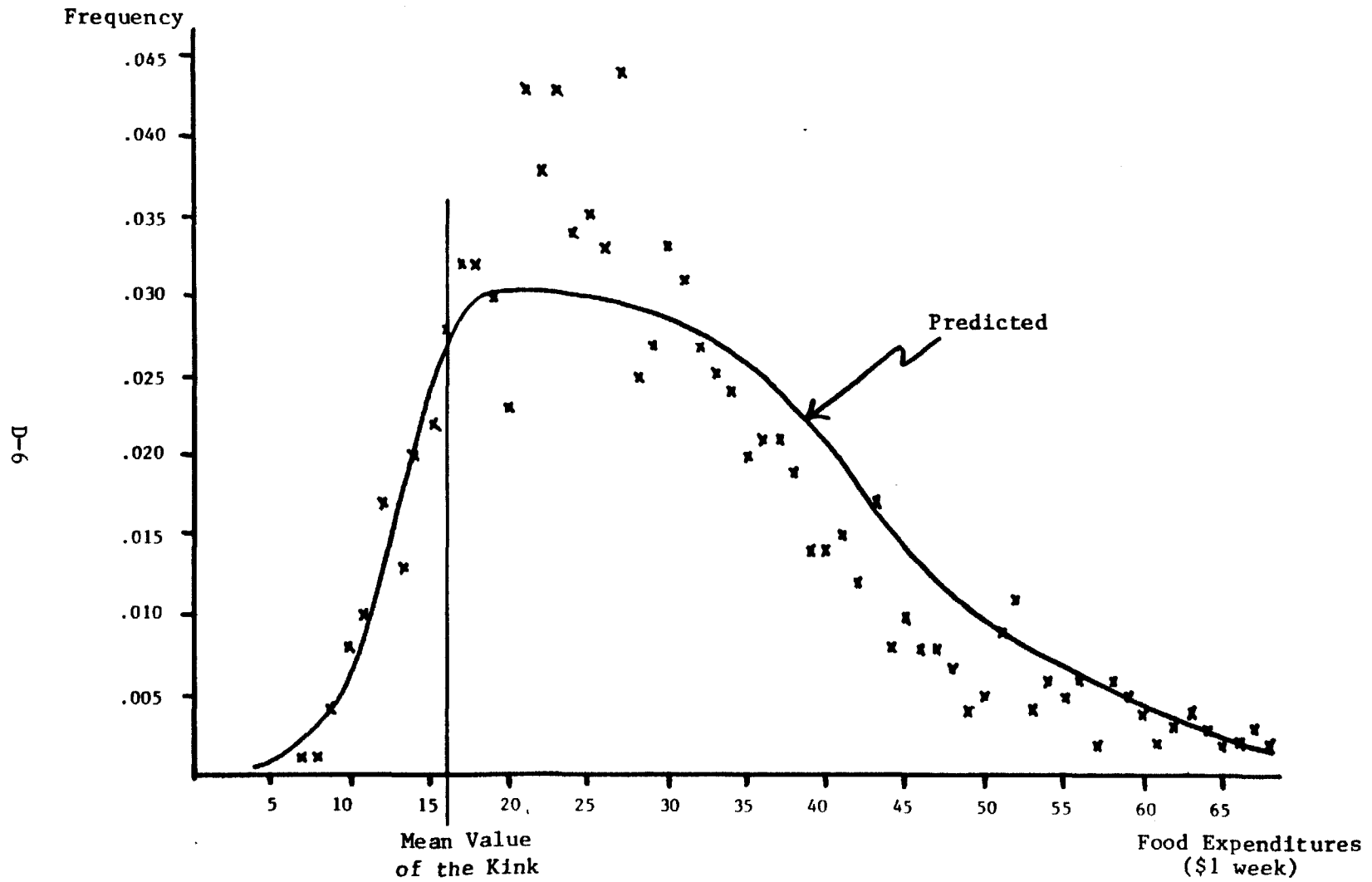
around the kink in the data. Estimation of equations (2) and (3) above, generated values of zero for this parameter--that is, no detectable amount of clustering was found. Equation (1) generated a non-zero value for the clustering parameter but for incorrect reasons. This is illustrated in Figure D.1, which shows the distribution of food expenditures predicted by equation (1), along with the actual distribution of the data. As the figure indicates, the predicted distribution does have a kink around the mean kink value in the data, \$16. However, the underlying data show no clustering at that point, but rather a clustering almost \$10 higher, at around \$26. This clustering at \$26 could not be a result of the kink, as it is too far away. The estimates obtained for equation (1) "mistake" that clustering for a clustering around the kink.

Figure D.1 also reveals why the estimation of equation (2) revealed no clustering. That equation assumes that the underlying data have a logarithmic distribution. As the figure indicates, the underlying data have an approximately log-normal distribution. Thus, when equation (2) is estimated, the clustering in the data around \$26 is not mistaken for a clustering around the kink, but rather is correctly interpreted as the peak of a log-normal distribution. The estimates indicate that, when the distribution of the underlying data is correctly modeled, there is no clustering in the data.

In summary, this investigation of the 1977 data failed to reveal any impact of the purchase requirement on food expenditures. Therefore, the comparisons of 1977 and 1984 results to obtain the estimates of NAP effects that are presented in the body of this report are not biased by the absence of controls for EPR effects.

FIGURE D.1

ACTUAL AND PREDICTED DENSITY OF FOOD EXPENDITURES



APPENDIX E
SUPPLEMENTAL TABLES